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Hotes

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(54) **COLLAPSIBLE FRAME FOR A PORTABLE SHELTER**

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(22) Filed: **Nov. 25, 2014**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 13/790,842, filed on Mar. 8, 2013, now Pat. No. 9,097,034.

(60) Provisional application No. 61/651,365, filed on May 24, 2012.

(51) **Int. Cl.**

E04H 15/48	(2006.01)
E04H 15/32	(2006.01)
E04H 9/14	(2006.01)

(52) **U.S. Cl.**

CPC ***E04H 15/48*** (2013.01); ***E04H 15/32*** (2013.01); *E04H 9/14* (2013.01); *Y10T 29/49716* (2015.01)

(58) **Field of Classification Search**

CPC E04H 15/48; E04H 15/34; E04H 15/44; E04H 15/36; E04C 3/005; E04C 3/02; E04B 1/344; E04B 1/34357; Y10T 29/49716

USPC 135/121–124, 120.1, 120.3, 132, 138, 135/144, 147, 151–154; 403/85, 93, 97–98, 403/101, 170; 52/645–646, 656.9, 83

See application file for complete search history.

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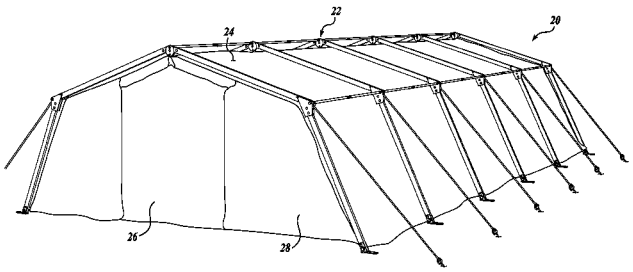
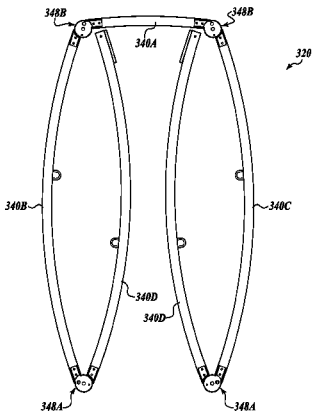
(74) *Attorney, Agent, or Firm* — Kenyon & Kenyon LLP

(57) **ABSTRACT**

In a portable shelter frame, a frame support is selectively articulable between an erected state and a collapsed state. The frame support includes a central frame member; a pair of upper arcuate frame members rotatably coupled to the ends of the central frame member, each pair of frame upper frame members being selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state; and a pair of lower arcuate frame members rotatably coupled to the other ends of the upper arcuate frame members, each pair of frame lower frame members being selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state. A frame assembly may include two more of the frame supports, purlin assemblies interconnecting the frame supports, respectively, each purlin assembly including first and second purlin members rotatably coupled about a purlin mid-joint, a first end of the purlin assembly being pivotally coupled to one of the frame supports, and a second end of the purlin assembly being pivotally coupled to another frame support, the purlin assembly being selectively lockable in an extended position when the frame is in the erected state, the purlin members being rotatable to a folded position when the frame is in the collapsed state.

19 Claims, 23 Drawing Sheets





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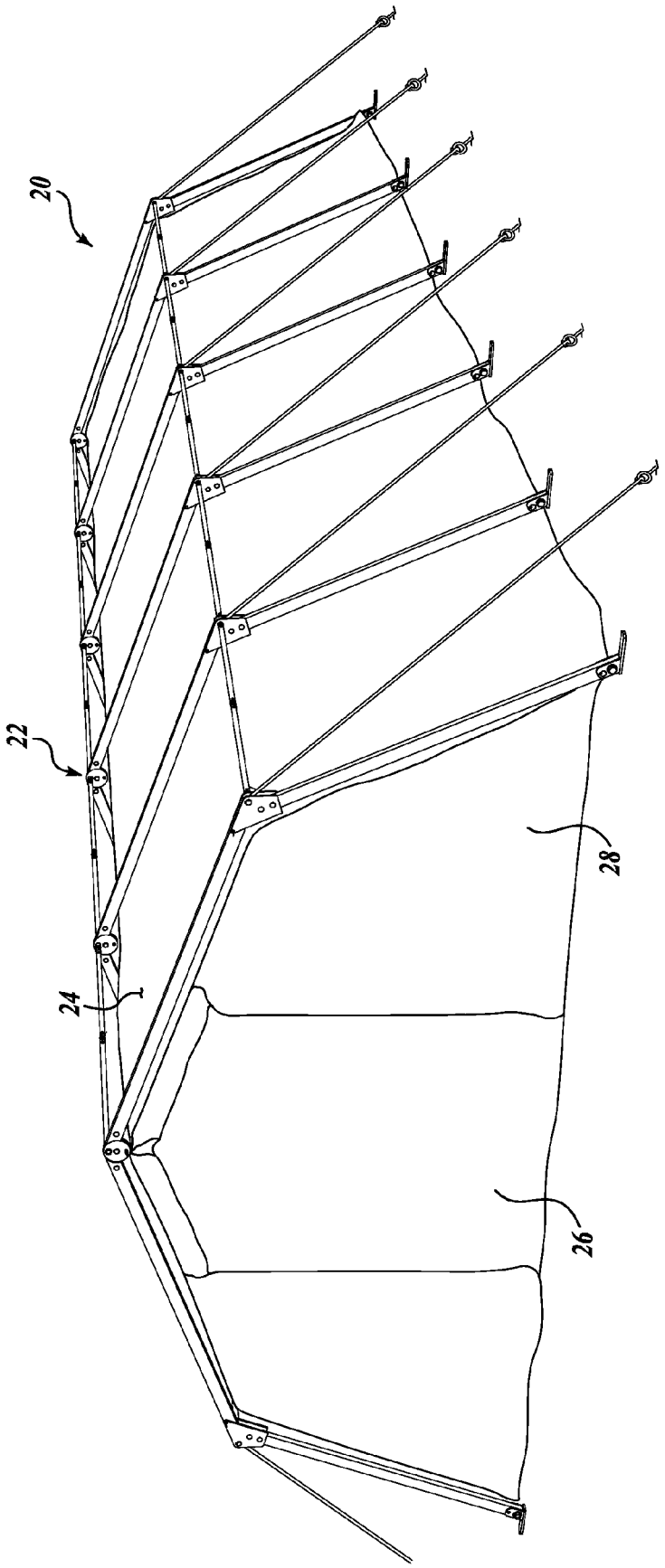

Fig. 1.

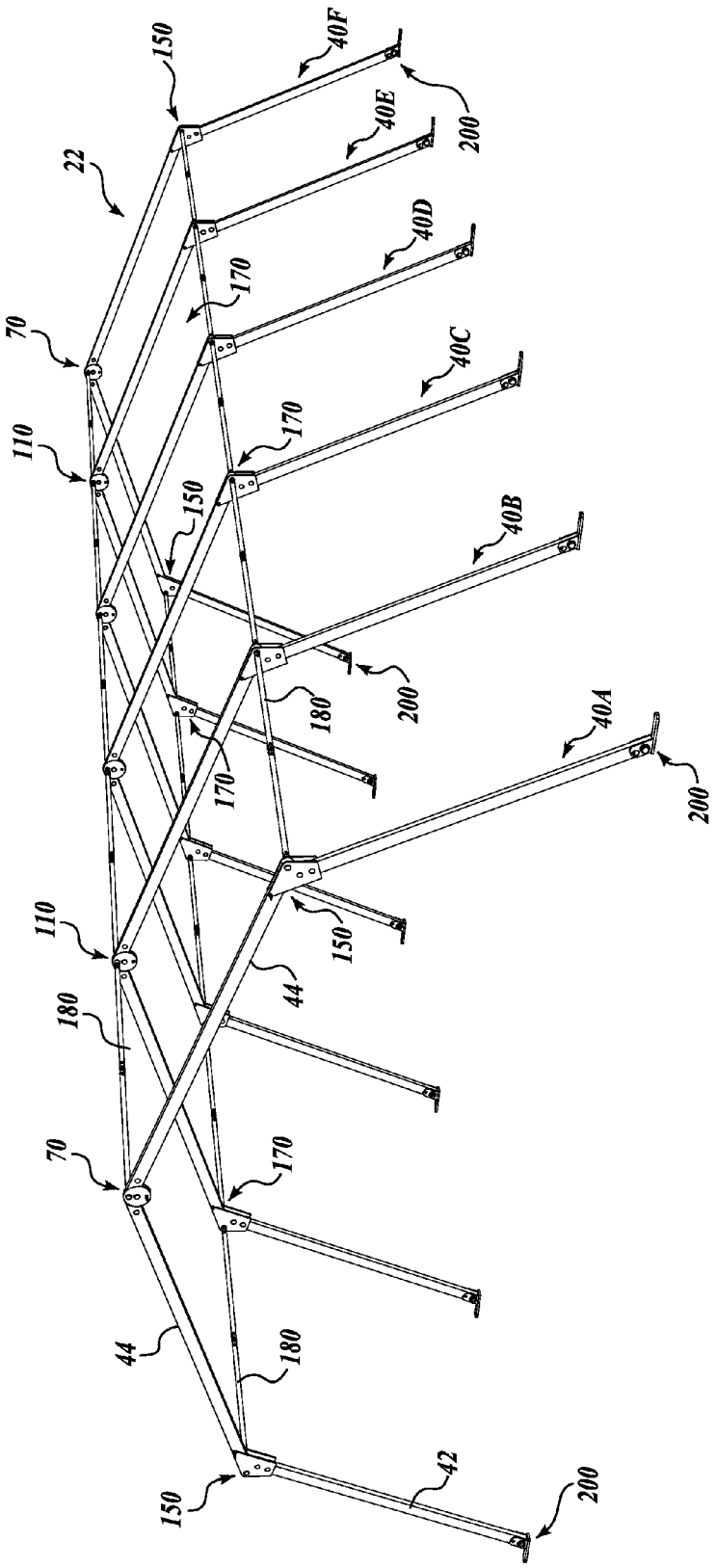
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Fig. 2.

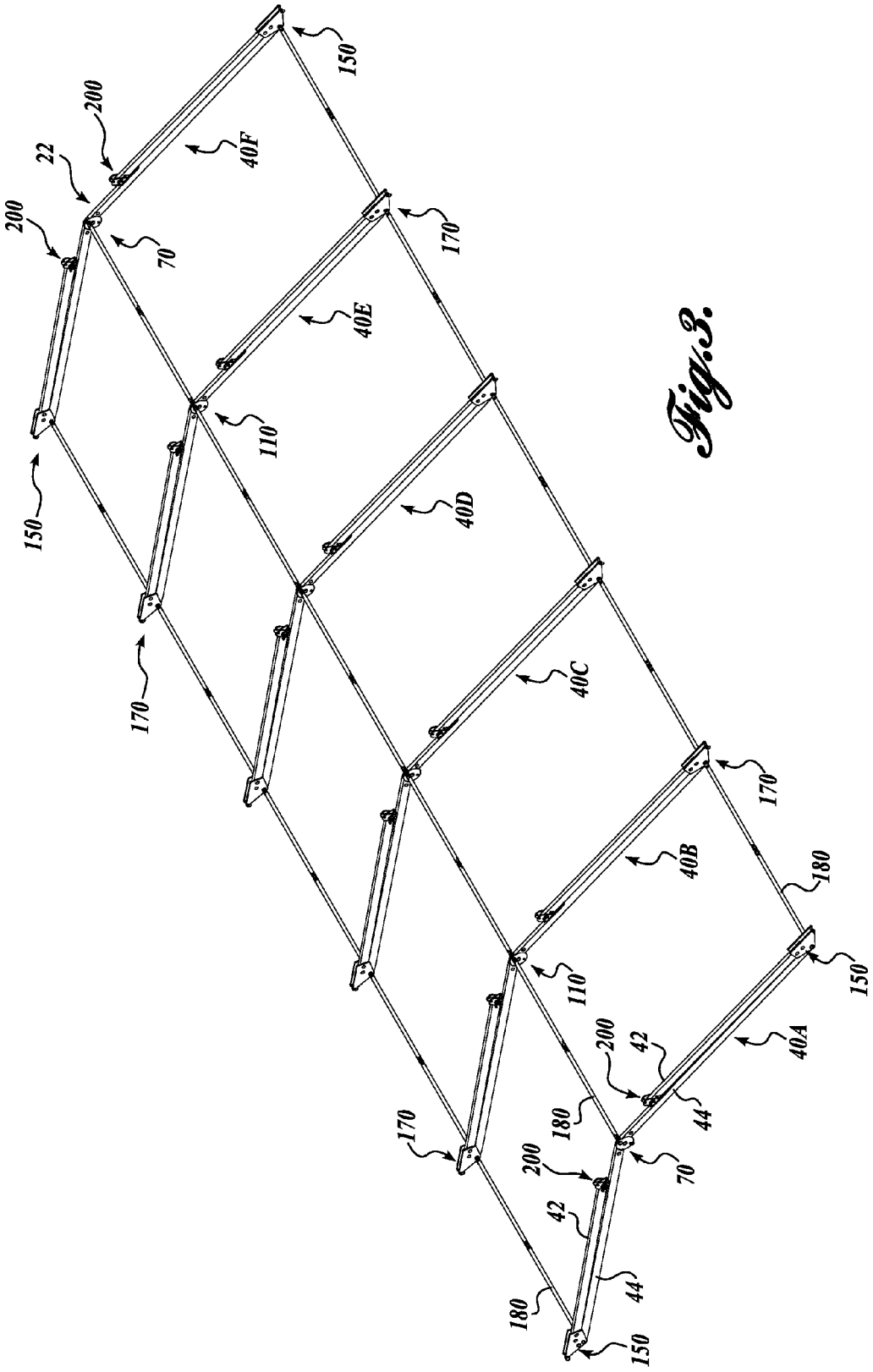
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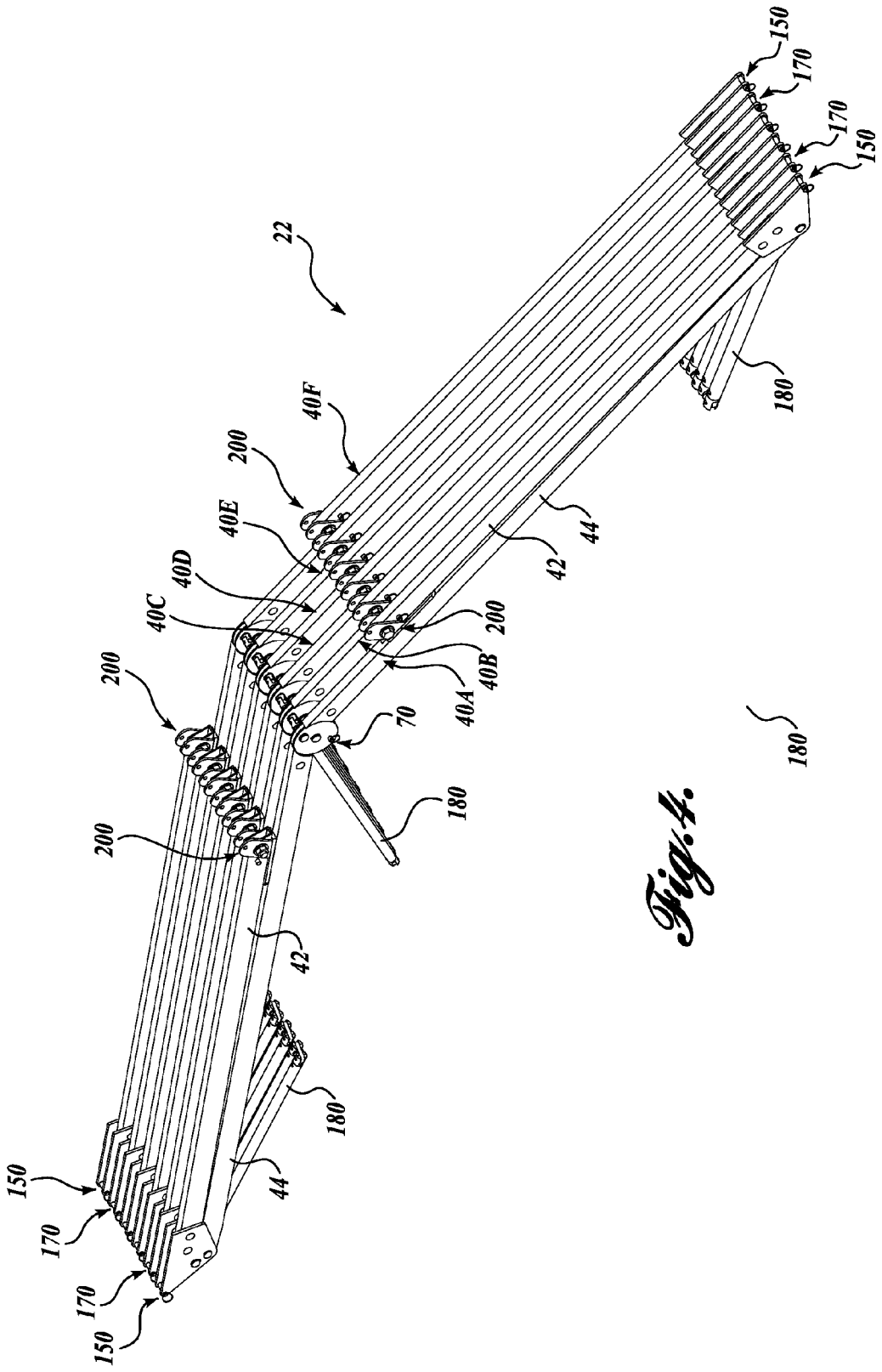
Fig. 3.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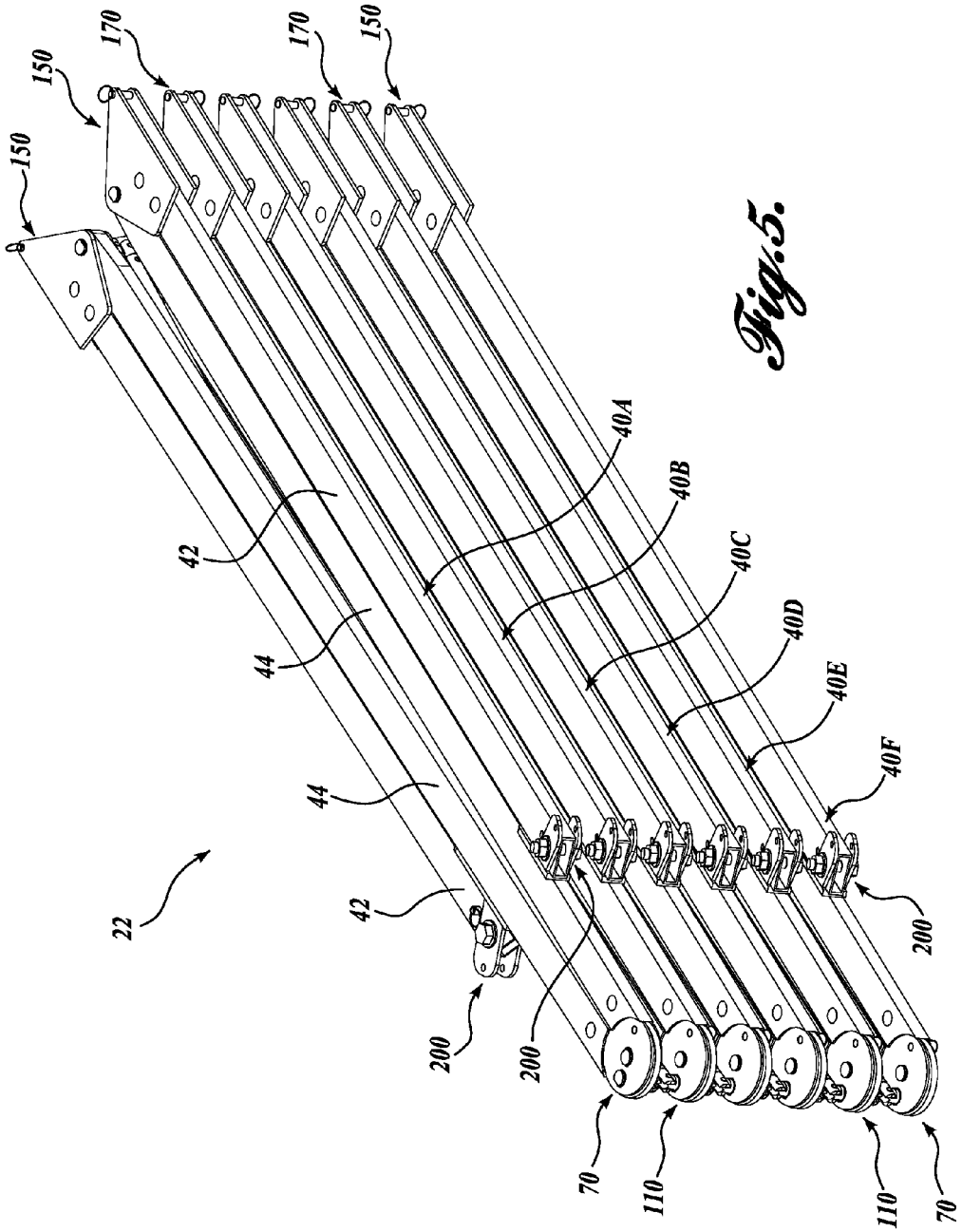
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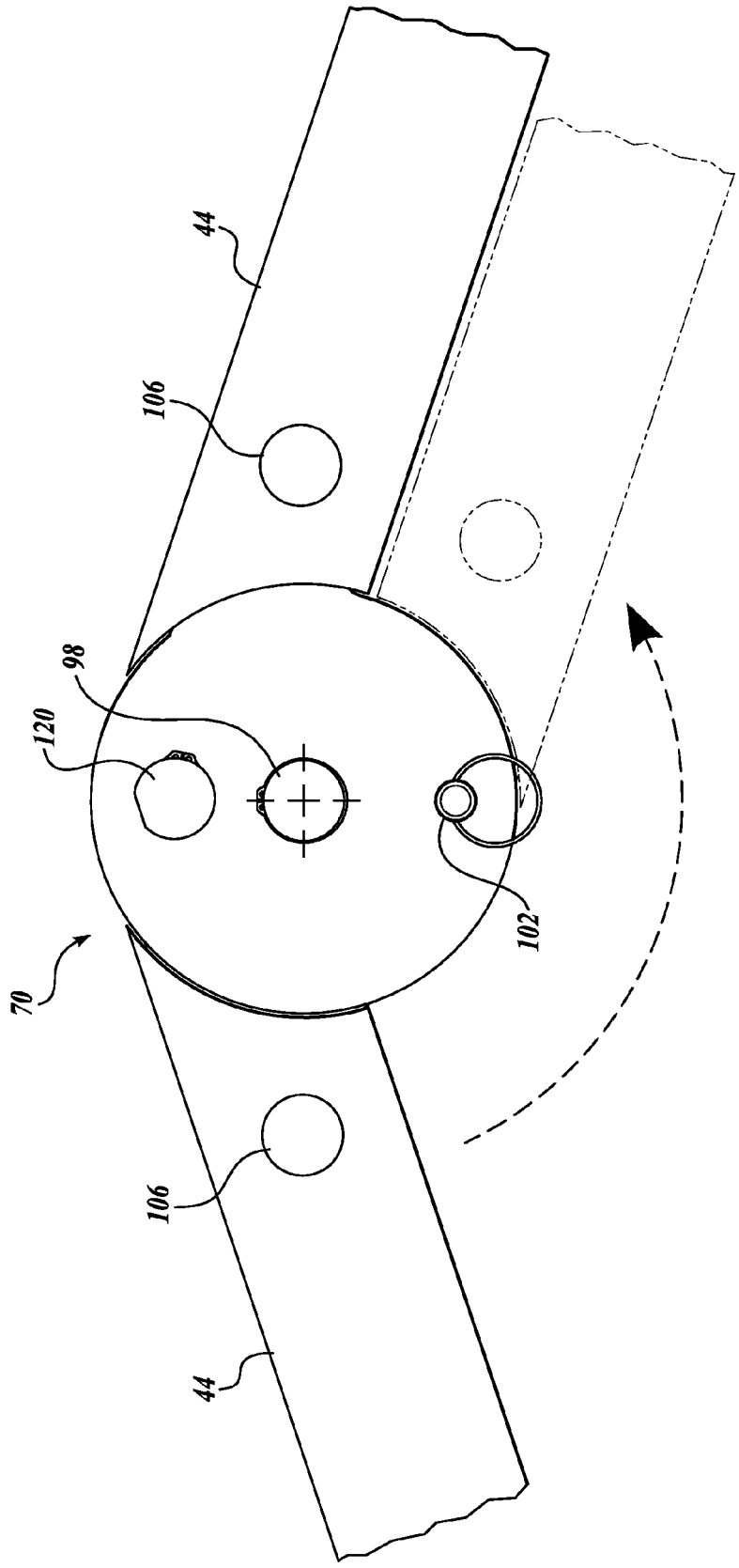
Fig. 5.



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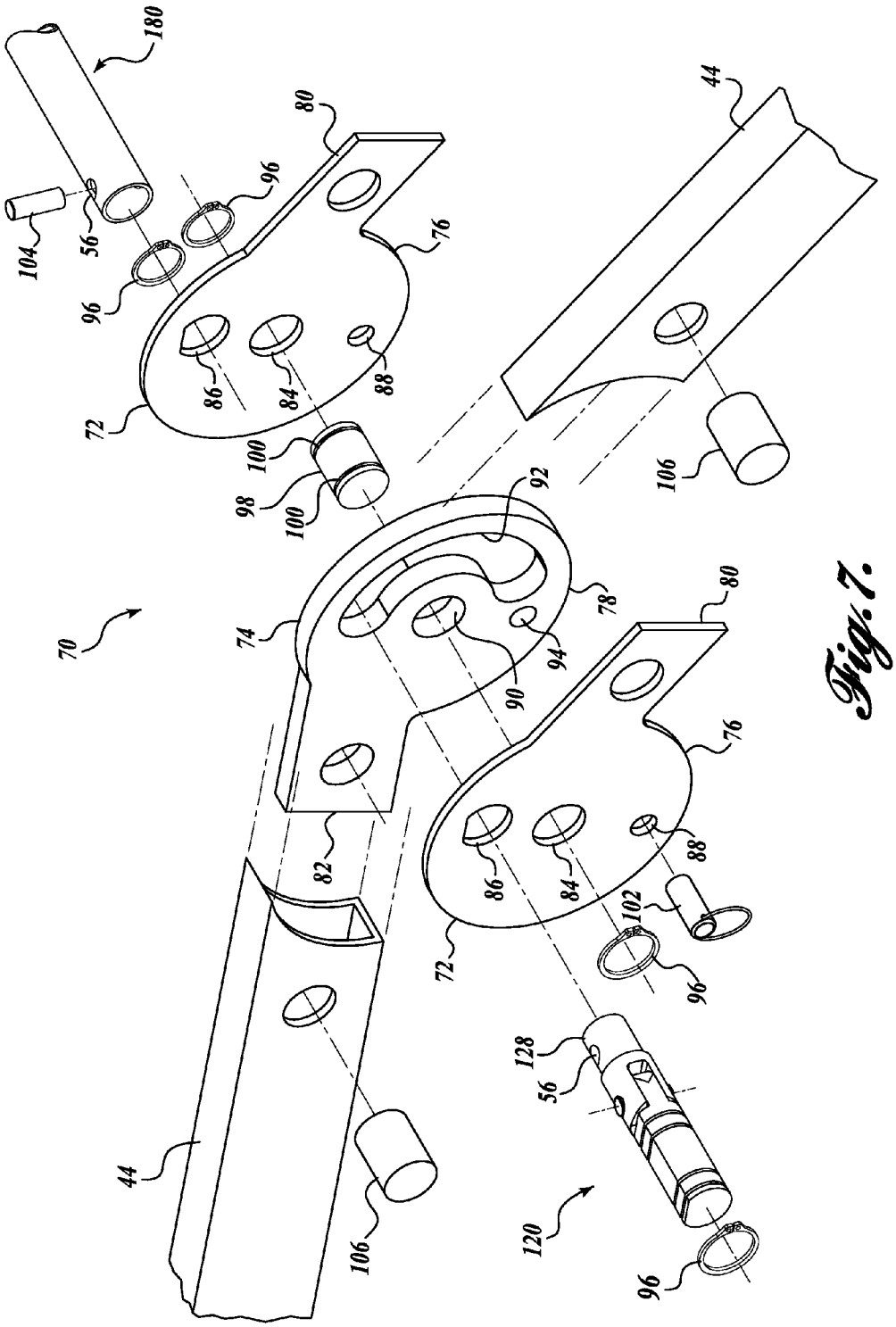
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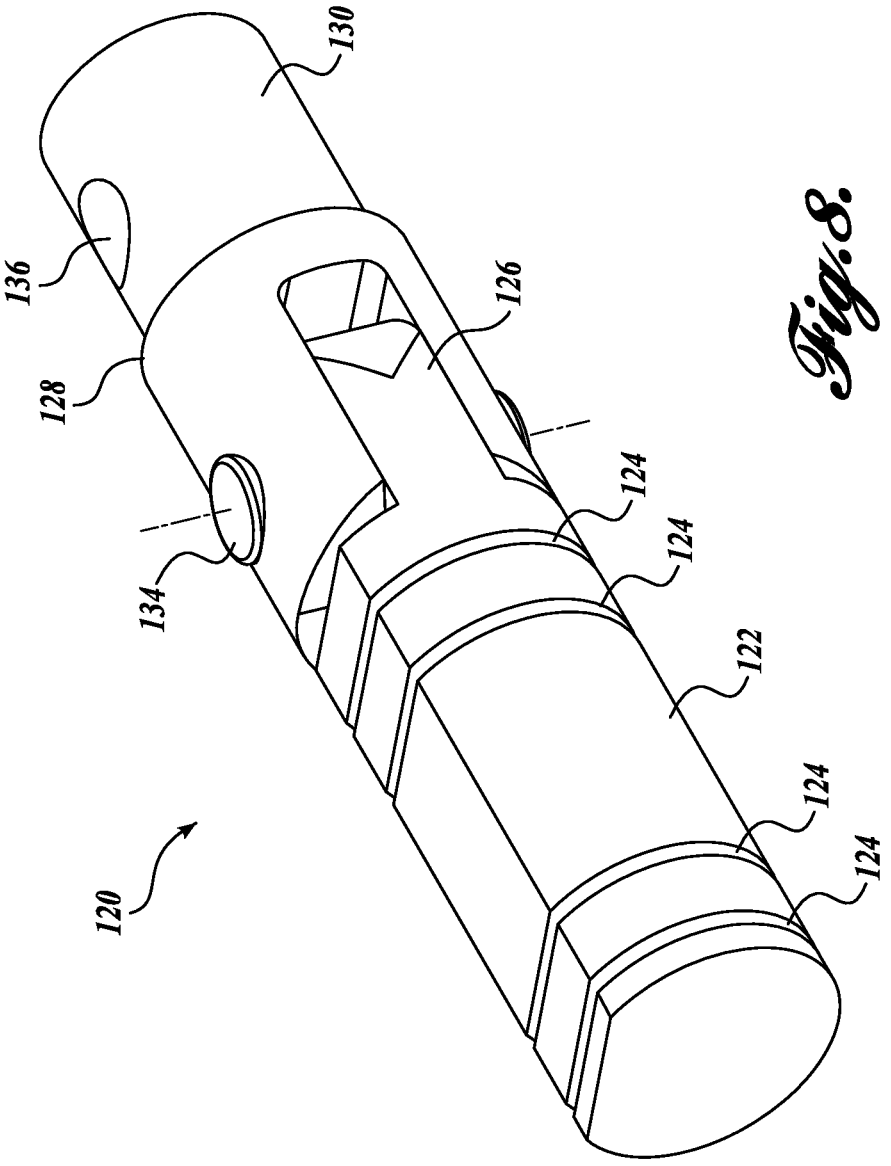
Fig. 7.



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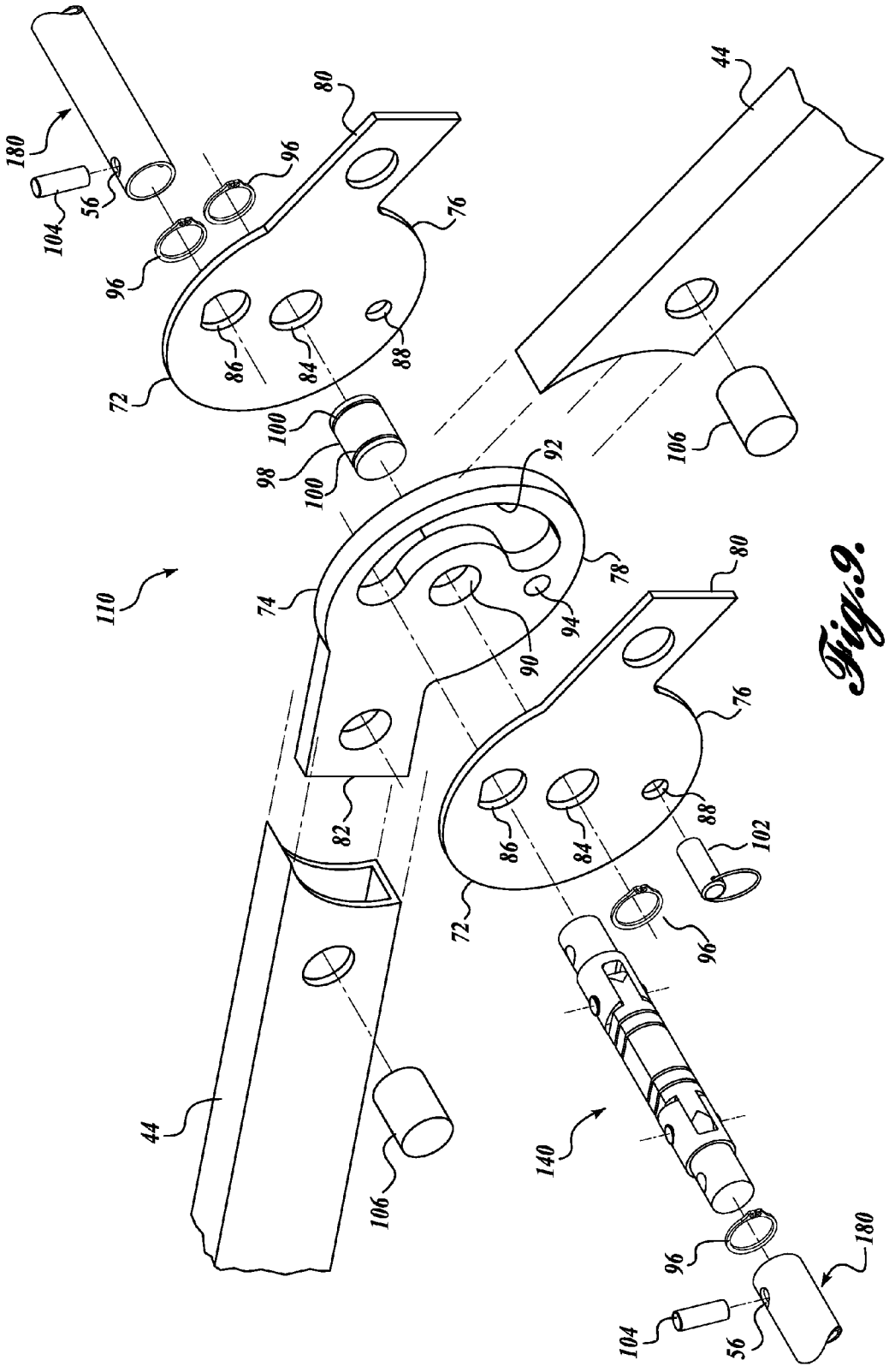
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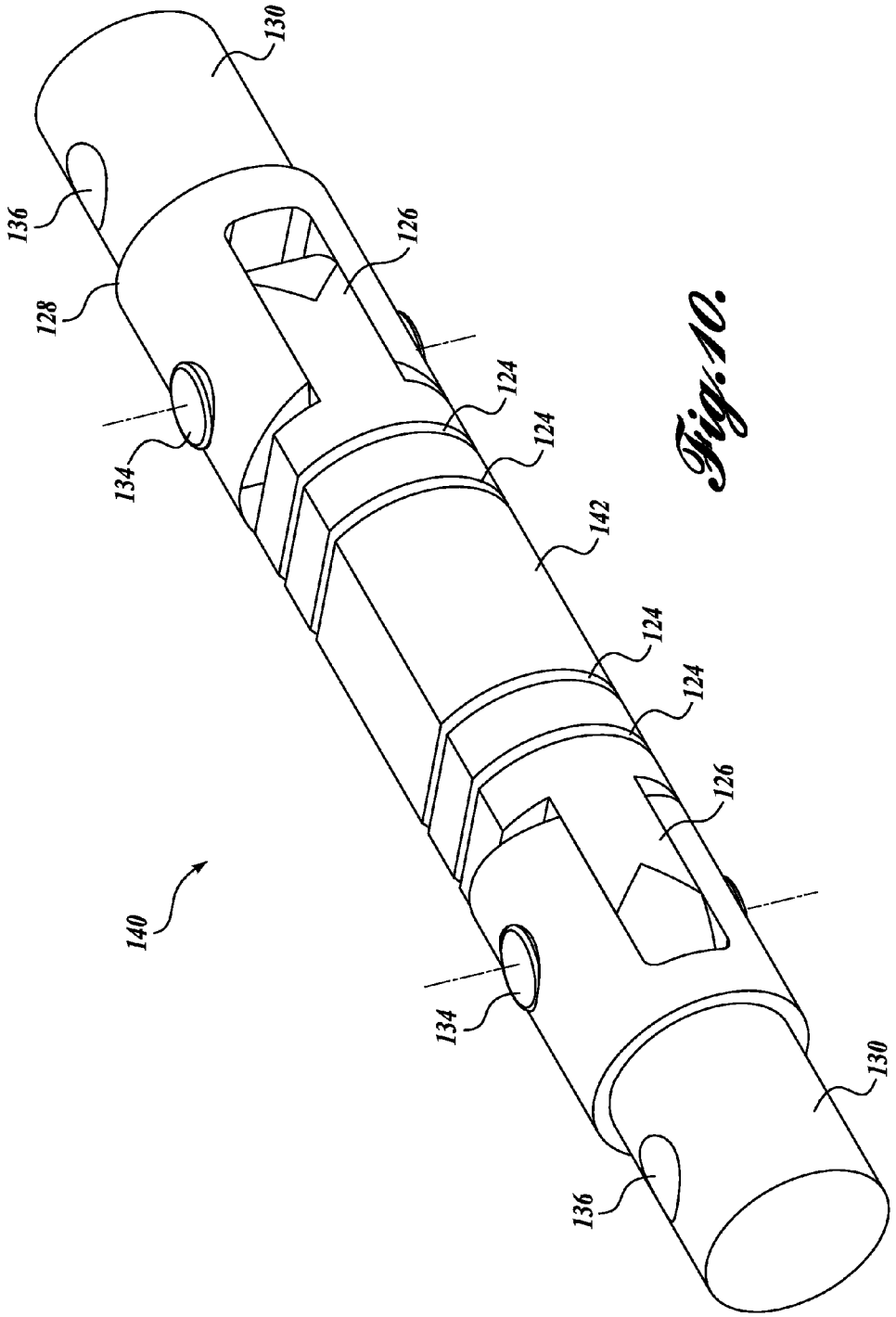
Fig. 9.



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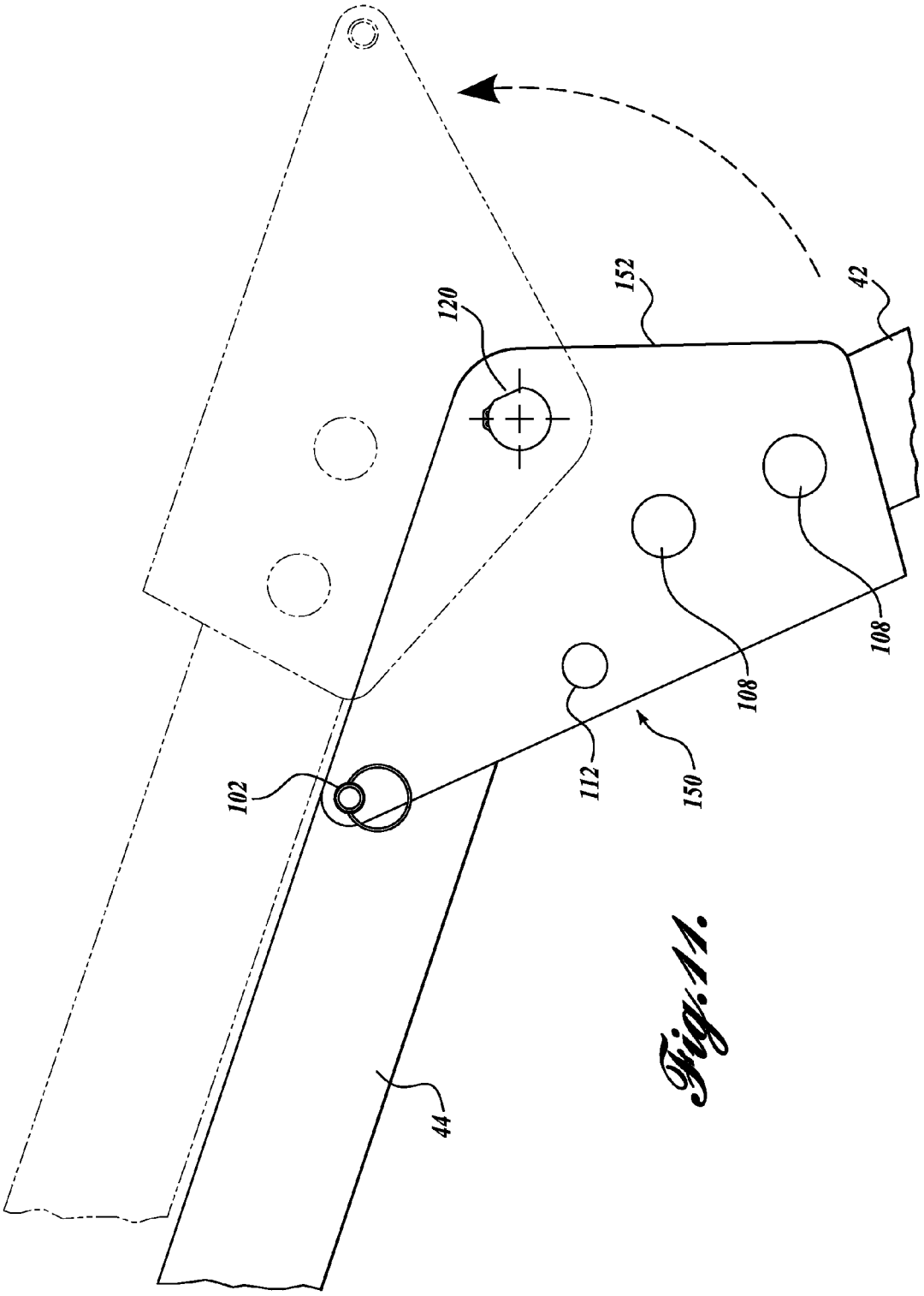

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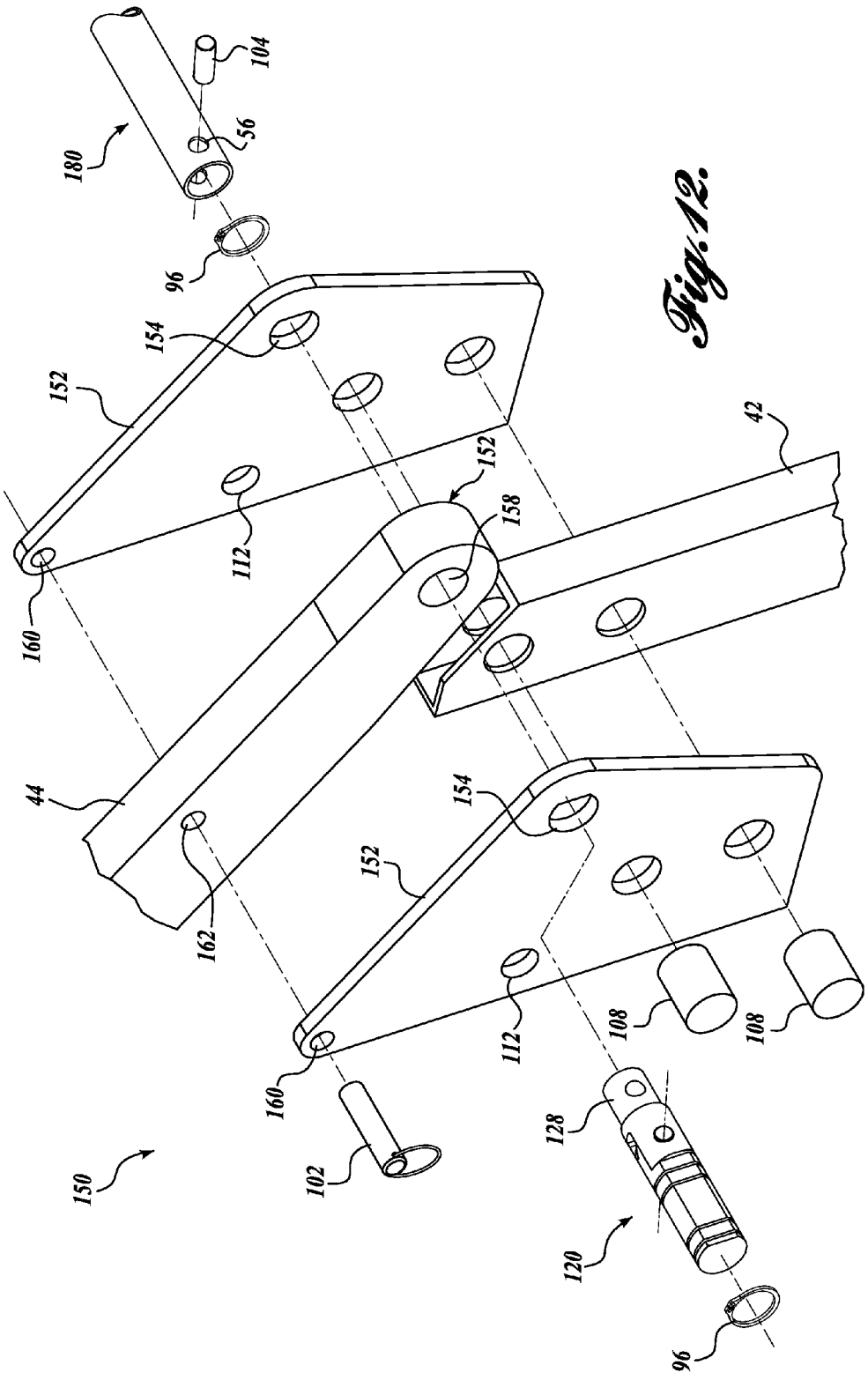

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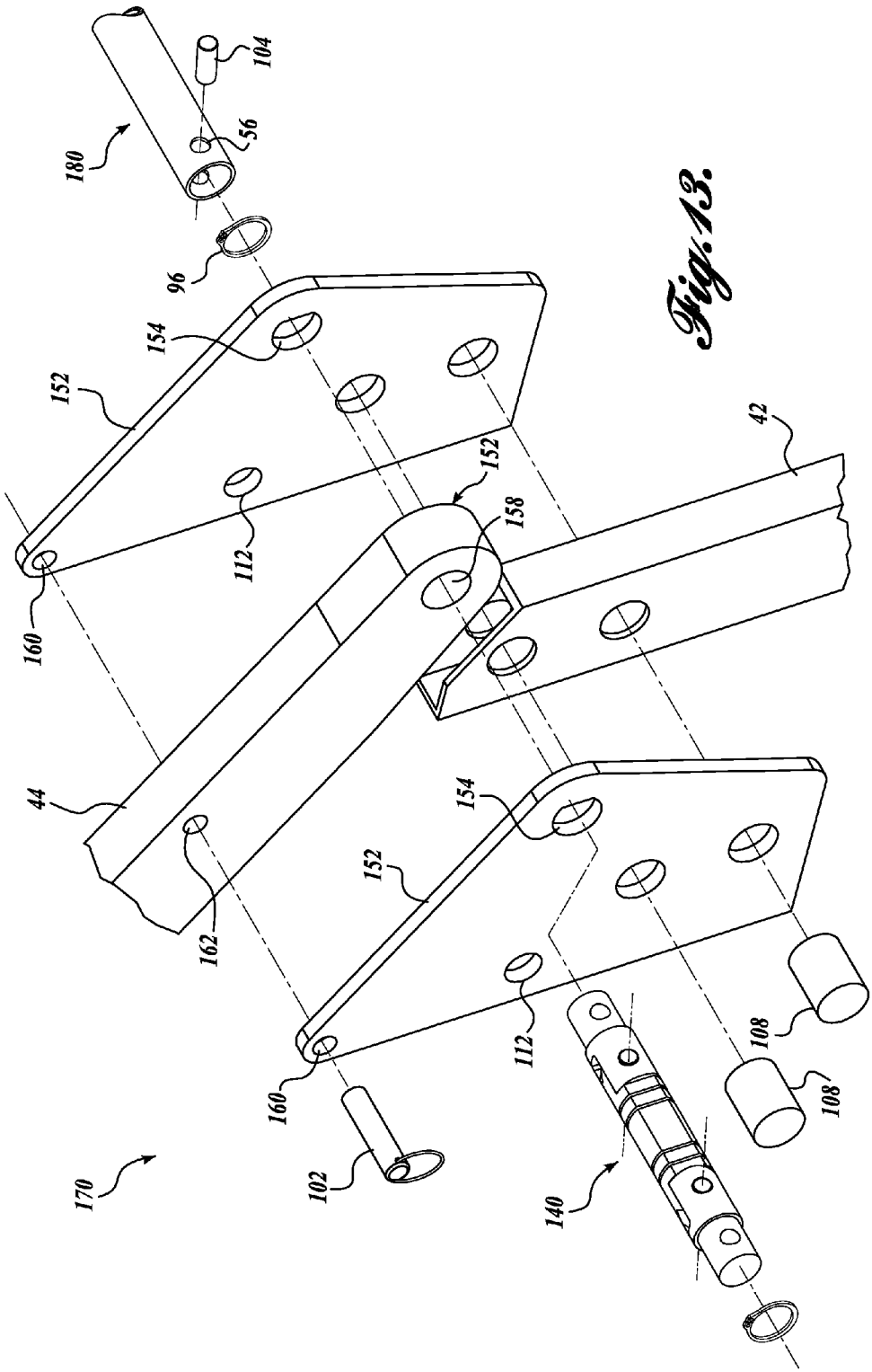
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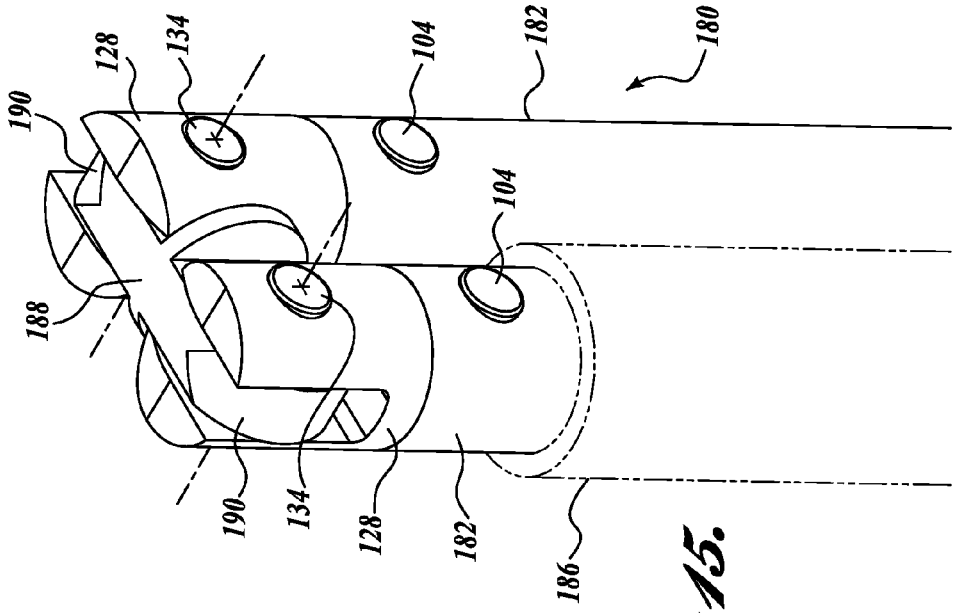
Fig. 13.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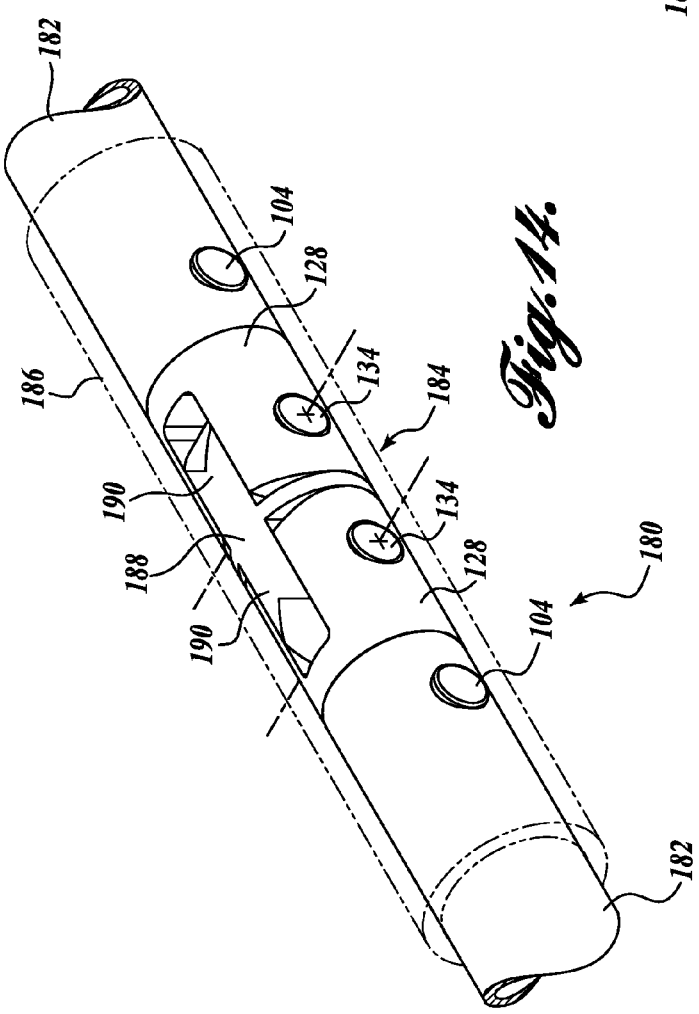
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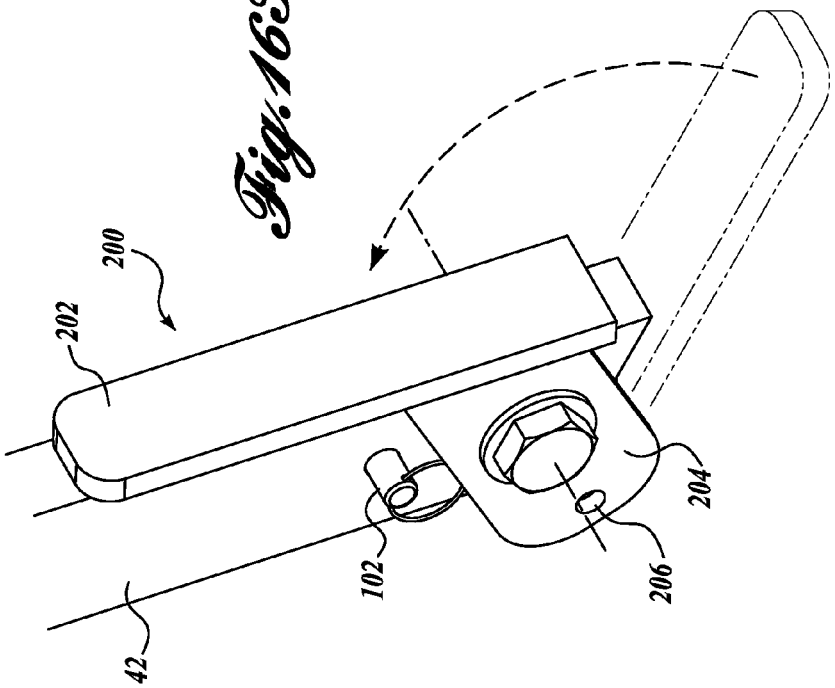
Fig. 14.

Fig. 16B.



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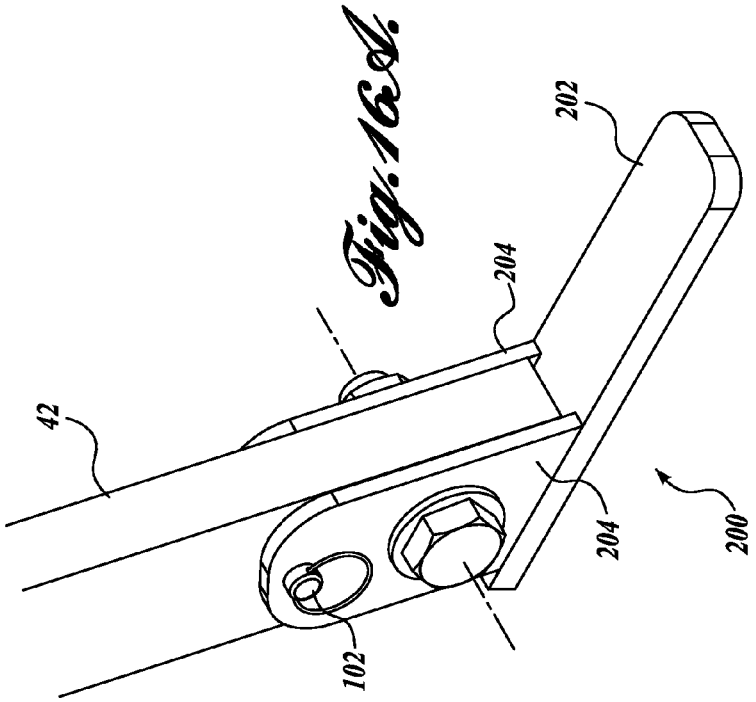

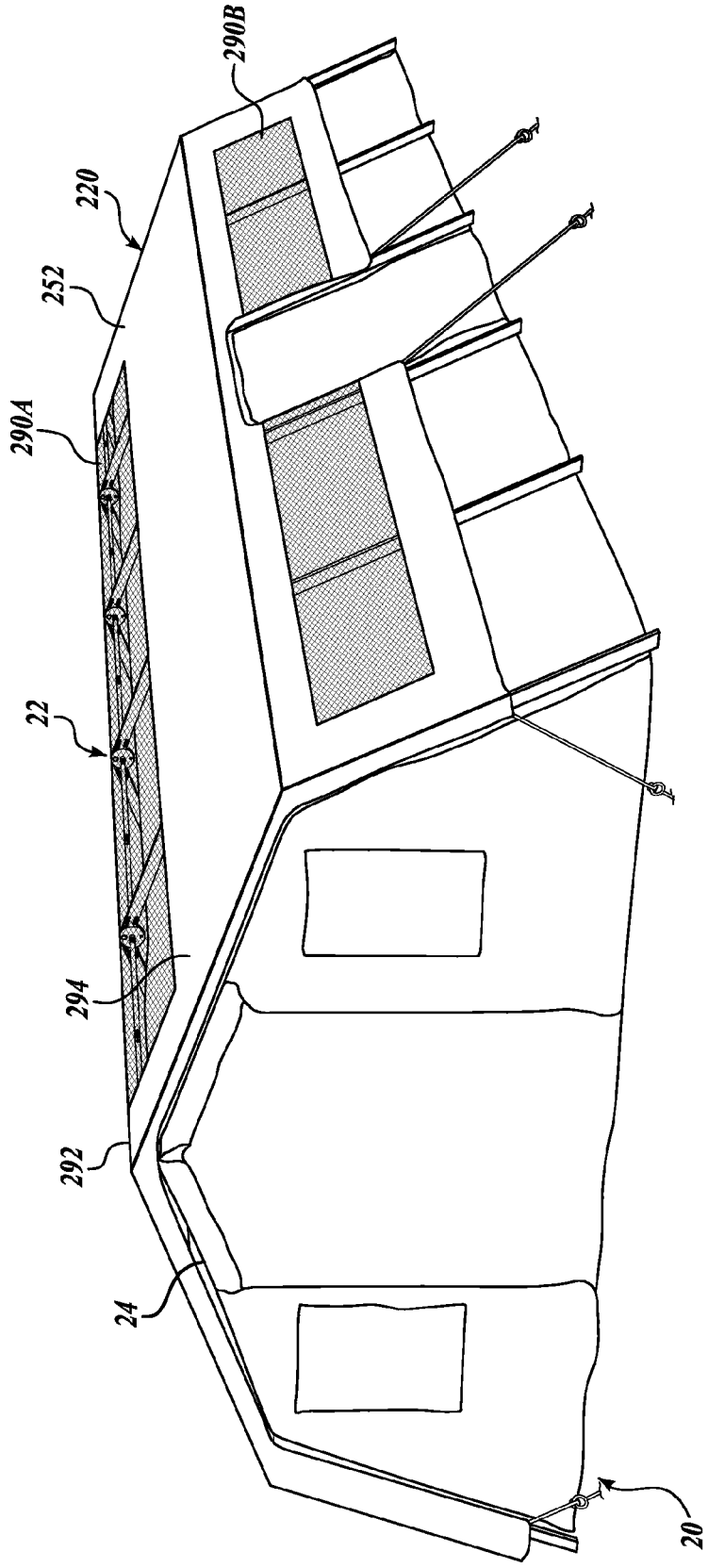

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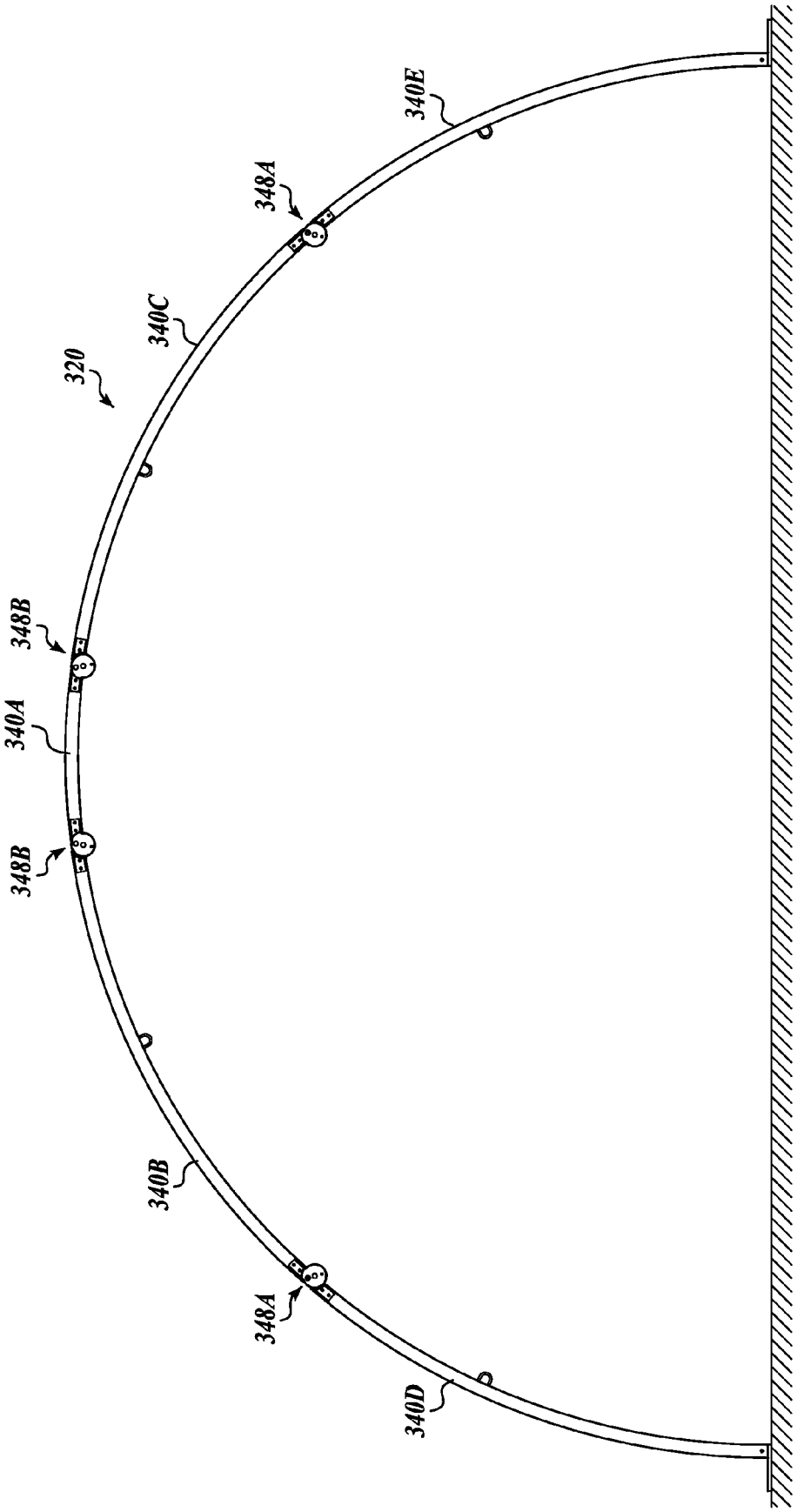

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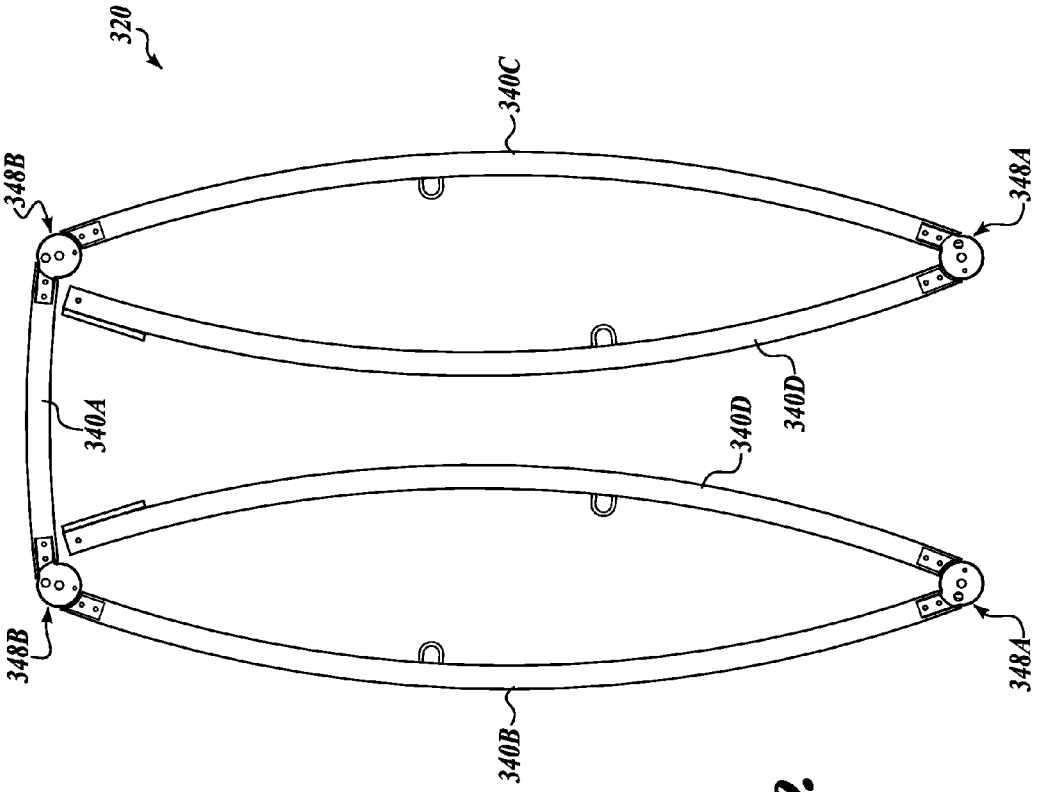

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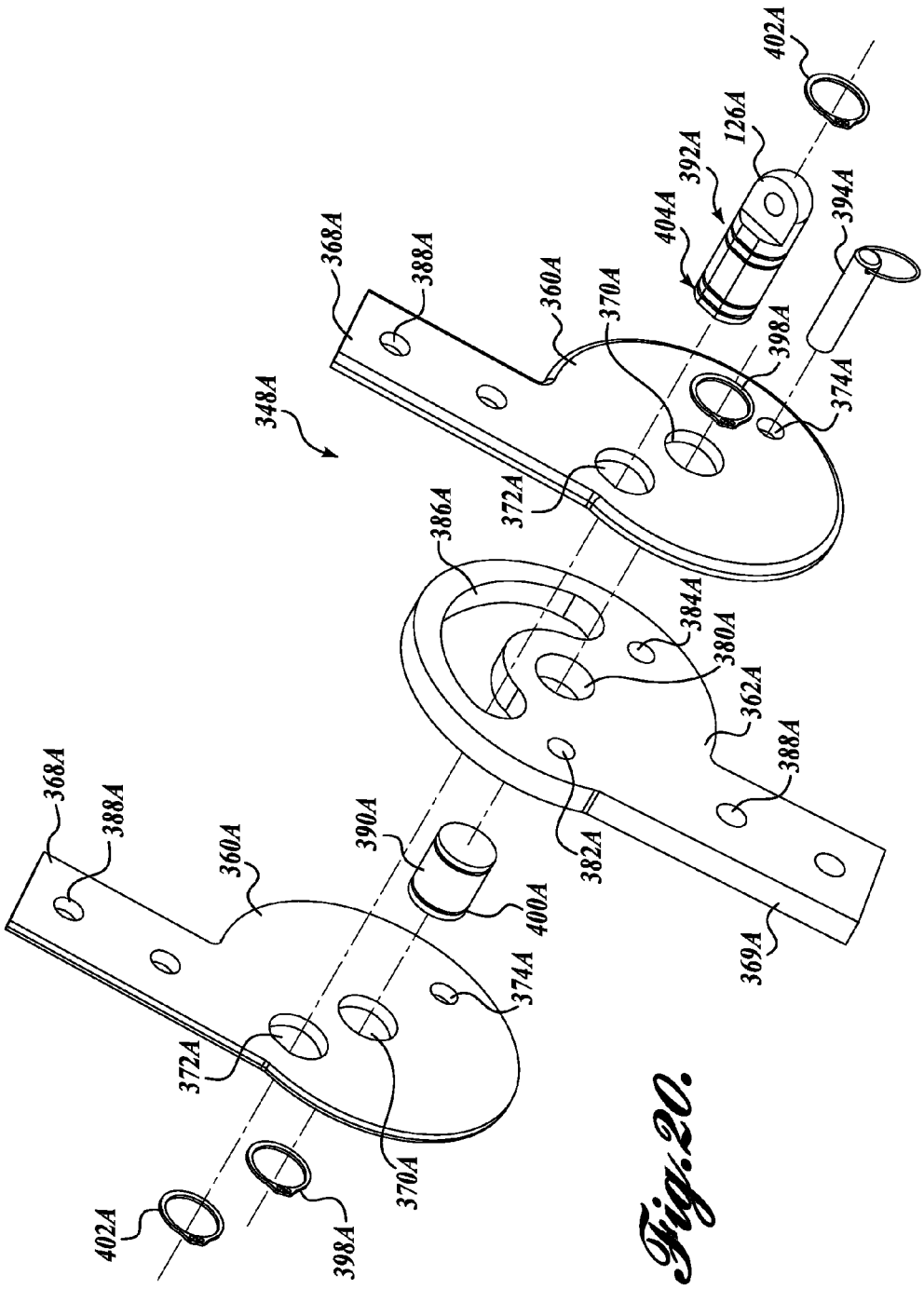
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Fig. 20.

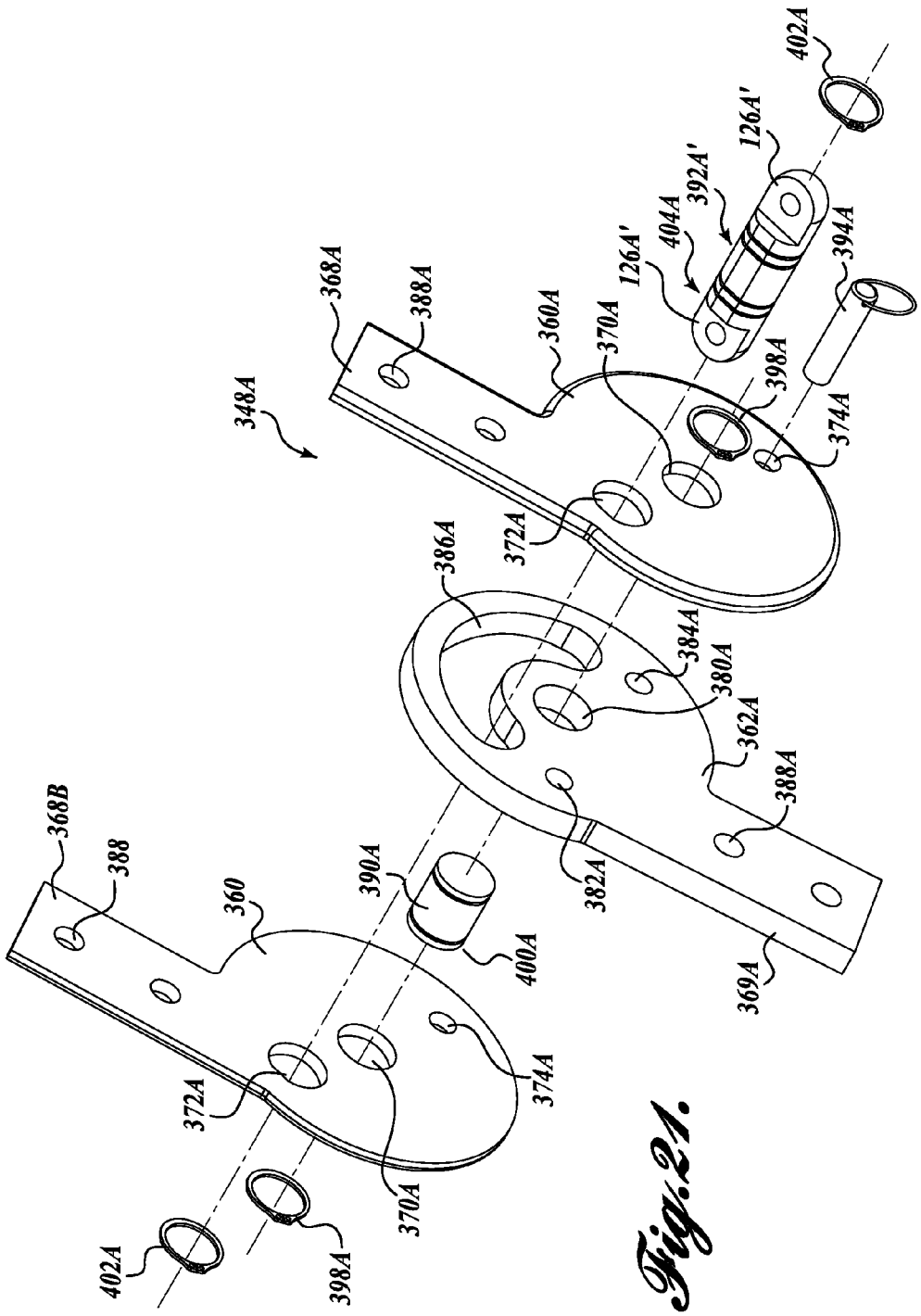
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Fig. 21.

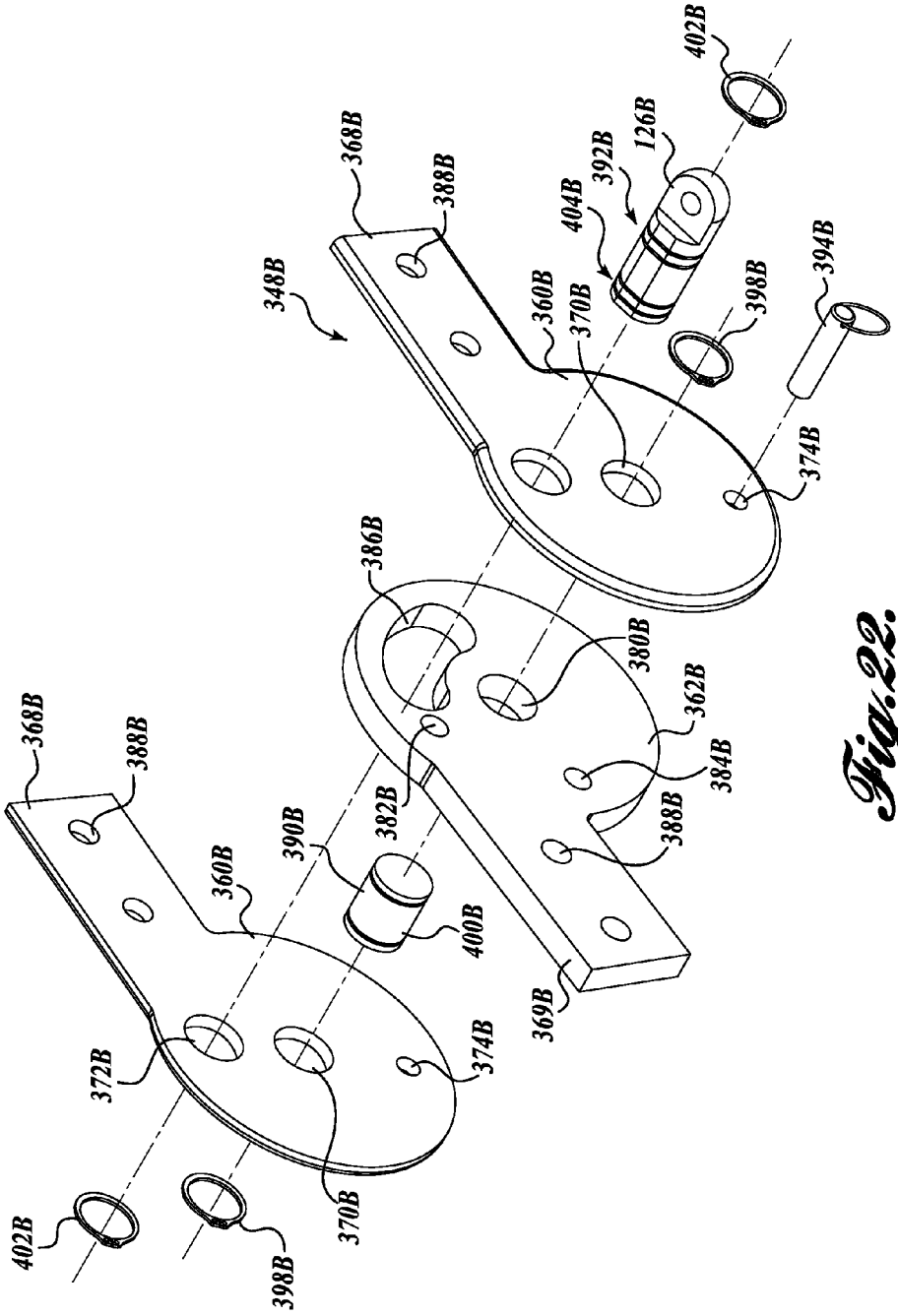
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Fig. 22.

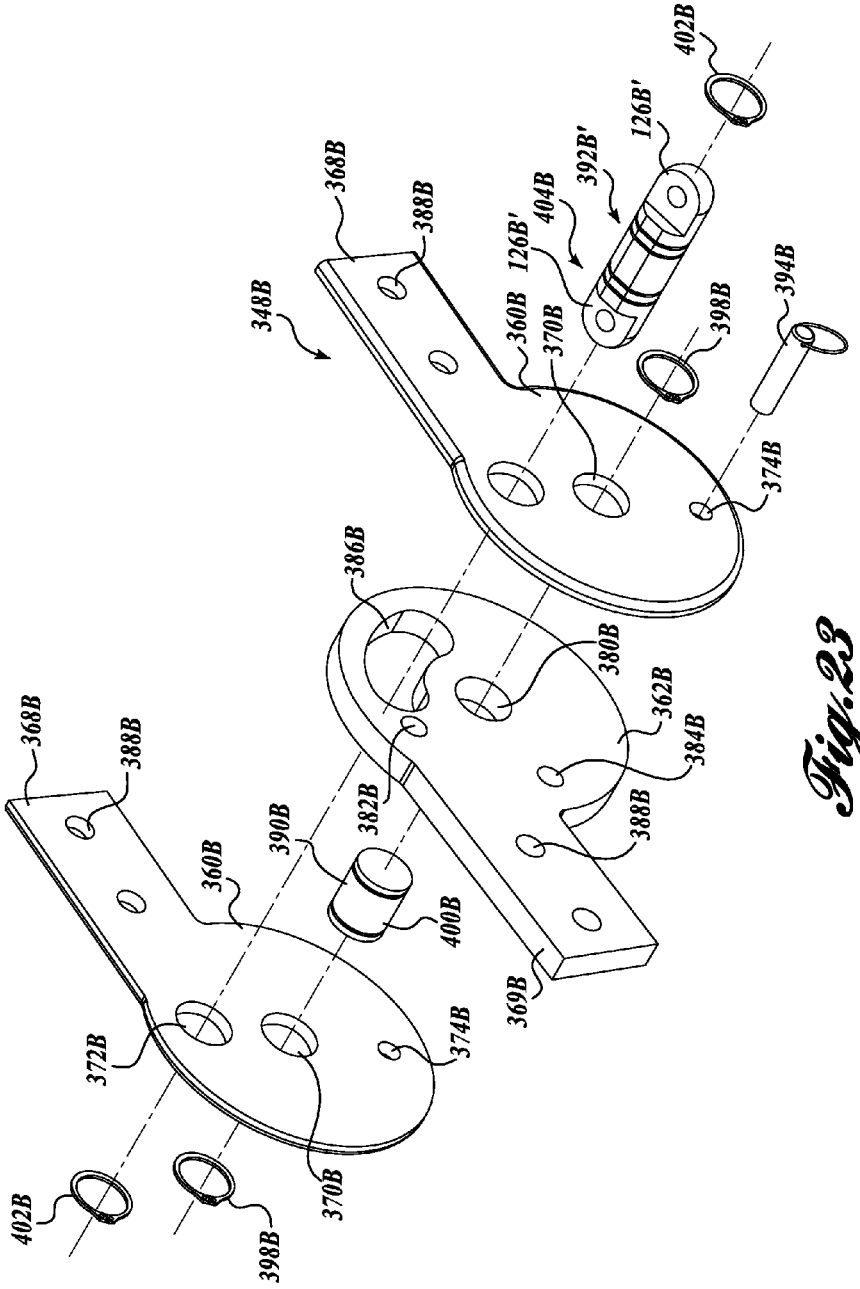
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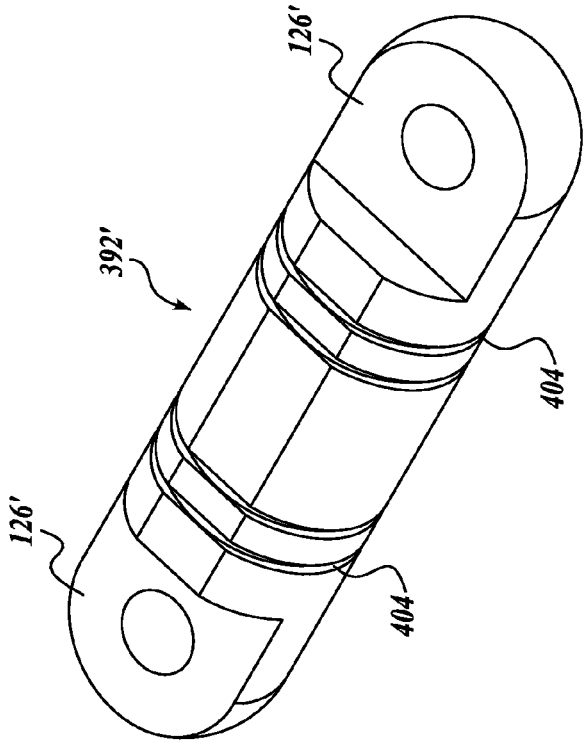
Fig. 23



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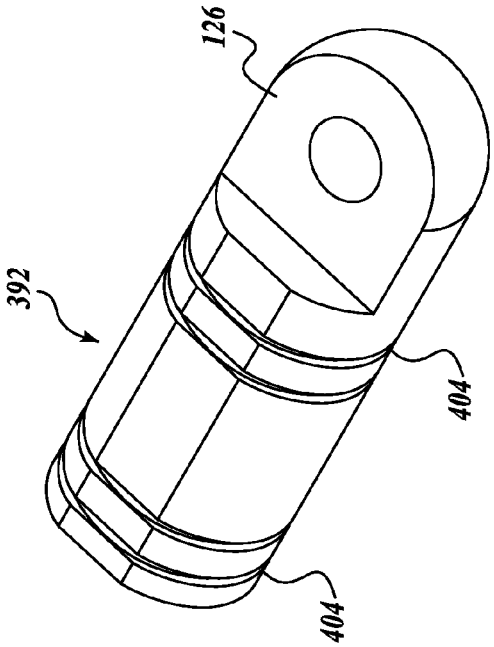

Fig. 24.

COLLAPSIBLE FRAME FOR A PORTABLE SHELTER

This application is a continuation in part of U.S. application Ser. No. 13/790,842, filed Mar. 8, 2013, benefit of which is hereby claimed under 35 U.S.C. §120. U.S. application Ser. No. 13/790,842 claims the benefit of U.S. Provisional Patent Application No. 61/651,365, filed May 24, 2012. The present application incorporates both of the above-referenced applications by reference in their entirety.

BACKGROUND

Portable shelters are commonly used by the U.S. military and others, and are occupiable for temporarily housing military or other personnel, equipment, and/or supplies, or for providing services such as cooking, dining or medical care. Portable shelters are also used by organizations that provide humanitarian aid throughout the world. Such organizations commonly need to erect portable shelters in areas that have suffered from natural disasters, such as floods, tsunamis, hurricanes and the like. Ideally, these shelters should be designed for storage in a compact configuration that can be easily transported to a new destination for assembly and built for rugged use. Moreover, these shelters should be lightweight to make transportation easier and to make set up and disassembly manageable by a minimum number of people. Preferably, the assembly and disassembly process should be relatively quick and easy and require few hand tools.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of the claimed subject matter will be readily appreciated by reference to the following detailed description, taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is an isometric view of one representative embodiment of a temporary shelter having a collapsible frame formed in accordance with aspects of the present disclosure;

FIG. **2** is an isometric view of a collapsible frame of FIG. **1**, the frame being in an erected state;

FIG. **3** is an isometric view of a collapsible frame of FIG. **2**, the frame being in a first semi-collapsed state;

FIG. **4** is an isometric view of a collapsible frame of FIG. **2**, the frame being in a second semi-collapsed state;

FIG. **5** is an isometric view of a collapsible frame of FIG. **2**, the frame being in a collapsed state;

FIG. **6** is an end view of one embodiment of a center frame joint formed in accordance with aspects of the present disclosure;

FIG. **7** is an exploded partial isometric view of the center frame joint of FIG. **6**, the end frame joint being a single purlin joint;

FIG. **8** is an isometric view of a pivot pin assembly of the center frame joint of FIG. **7**;

FIG. **9** is an exploded partial isometric view of the center frame joint of FIG. **6**, the center frame joint being a double purlin joint;

FIG. **10** is an isometric view of a pivot pin assembly of the center frame joint of FIG. **9**;

FIG. **11** is an end view of one embodiment of a lateral frame joint formed in accordance with aspects of the present disclosure;

FIG. **12** is an exploded partial isometric view of the lateral frame joint of FIG. **11**, the lateral frame joint being joint being a single purlin joint;

FIG. **13** is an exploded partial isometric view of the lateral frame joint of FIG. **11**, the lateral frame joint being joint being a double purlin joint;

FIG. **14** is a partial isometric view of a purlin mid joint formed in accordance with aspects of the present disclosure;

FIG. **15** is an exploded partial isometric view of the purlin mid joint of FIG. **14**;

FIGS. **16**A and **16**B show isometric views of a rotatable foot in the extended and retracted positions, respectively, formed in accordance with aspects of the present disclosure;

FIG. **17** is an example of the temporary shelter of FIG. **1** equipped with one embodiment of a solar fly in accordance with aspects of the present disclosure;

FIG. **18** is another example of a collapsible frame in accordance with aspects of the present disclosure, the collapsible frame disposed in an erected state;

FIG. **19** is an end view of an arched frame support formed in accordance with aspects of the present disclosure, the arched frame support disposed in a collapsed position;

FIG. **20** is an exploded view of one example of a joint formed in accordance with aspects of the present disclosure;

FIG. **21** is an exploded view of another example of a joint formed in accordance with aspects of the present disclosure;

FIG. **22** is an exploded view of another example of a joint formed in accordance with aspects of the present disclosure;

FIG. **23** is an exploded view of another example of a joint formed in accordance with aspects of the present disclosure;

FIG. **24** is a perspective view of one example of a guide pin in accordance with aspects of the present disclosure; and

FIG. **25** is a perspective view of one example of a guide pin in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

In one aspect, the invention relates to a frame support for a portable shelter frame, the frame support being selectively articulable between an erected state and a collapsed state. The frame support includes a central frame member; a pair of upper arcuate frame members rotatably coupled to the ends of the central frame member via first joints, each pair of frame upper frame members being selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state; and a pair of lower arcuate frame members rotatably coupled to the other ends of the upper arcuate frame members via second joints, each pair of frame lower frame members being selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state.

In another aspect, the invention relates to a frame assembly comprising at least first and second frame supports as just described, and purlin assemblies interconnecting the at least first and second frame supports at the first joints and the second joints, respectively, wherein each purlin assembly includes first and second purlin members rotatably coupled about a purlin mid-joint, a first end of the purlin assembly being pivotally coupled to the first frame support, a second end of the purlin assembly being pivotally coupled to the second frame support, the purlin assembly being selectively lockable in an extended position when the frame is in the erected state, the purlin members being rotatable to a folded position when the frame is in the collapsed state.

In another aspect, the invention relates to a frame assembly comprising a plurality of frame supports as just described, and a plurality of purlin assemblies interconnecting respective ones of the frame supports at respective first and second

joints, each purlin assembly including first and second purlin members rotatably coupled about a purlin mid-joint, and each purlin assembly being selectively lockable in an extended position when the frame is in the erected state, the purlin members being rotatable to a folded position when the frame is in the collapsed state.

In another aspect, the invention relates to a joint for connecting two arcuate frame members, the joint including at least first and second plate members, a pivot pin assembly defining an axis of rotation between the first and second plate members, and a guide pin associated with the first plate member and an arcuate slot disposed in the second plate member, wherein the guide pin travels within the arcuate slot as one of the two arcuate frame members moves between a first, fixed position and a second, fixed position.

The detailed description set forth below in connection with the appended drawings where like numerals reference like elements is intended as a description of various embodiments of the disclosed subject matter and is not intended to represent the only embodiments. Each embodiment described in this disclosure is provided merely as an example or illustration and should not be construed as preferred or advantageous over other embodiments. The illustrative examples provided herein are not intended to be exhaustive or to limit the claimed subject matter to the precise forms disclosed. Similarly, any steps described herein may be interchangeable with other steps, or combinations of steps, in order to achieve the same or substantially similar result.

The following discussion provides one or more examples of a frame for use with temporary shelters and the like. As will be described in more detail below, embodiments of the frame are collapsible and aid in the quick and easy assembly of a temporary shelter.

In the following description, numerous specific details are set forth in order to provide a thorough understanding of exemplary embodiments of the present disclosure. It will be apparent to one skilled in the art, however, that many embodiments of the present disclosure may be practiced without some or all of the specific details. In some instances, well-known process steps have not been described in detail in order not to unnecessarily obscure various aspects of the present disclosure. Further, it will be appreciated that embodiments of the present disclosure may employ any combination of features described herein.

Referring now to FIG. **1**, there is shown an example of a temporary shelter **20** formed in accordance with aspects of the present disclosure. In the embodiment shown, the shelter **20** is of the compact and portable type, and comprises a lightweight, easy-to-erect frame **22** and a durable, flexible, tent-like structure **24** suspended therefrom. The shelter **20** in some embodiments may include a door **26** in the end wall **28**. As will be described in more detail below, the frame **22** is collapsible from an erect state, as shown in FIG. **2**, to a collapsed state, as best shown in FIG. **5**.

As shown in FIG. **2**, the frame **22** includes a plurality of lightweight, interconnected frame supports **40**A-**40**F (shown as six) that extend transversely with respect to the longitudinal axis of the shelter **20**. When the frame **22** is erected, the frame supports **40**A-**40**F are vertically aligned, equally spaced apart, and interconnected with adjacent frame supports by a plurality of horizontally aligned purlin assemblies **180**.

Each frame support **40** comprises two elongate lateral members **42** and two elongate center members **44**, although different configurations wherein the frame support includes a different number of members are possible. As illustrated, each member **42** and **44** is formed from rectangular metallic tubing, such as rectangular aluminum tubing, so as to provide a lightweight support with sufficient strength to support the shelter **20**. The shape of the members **42** and **44** is not limited to the disclosed rectangular cross-section, but can be round, square, solid, or any other suitable shape. Moreover, while a lightweight metallic material, such as aluminum, is preferred, the members **42** and **44** can be formed of steel, composites, polymeric materials, or any other material having suitable strength. These and other variations as to the form of the members **42** and **44** will be appreciated by those of skill in the art and should be considered within the scope of the present disclosure.

In one embodiment, the frame members **42** and **44** and components of the purlin assemblies **180** are constructed out of 6061-T6 or 7075-T6 alloy aluminum tube and/or bar stock. Frame members and components made from 7075-T6 alloy, in particular, have similar strength to those made of steel, but with ⅓ the weight.

The center members **44** are hingedly connected end-to-end via a center frame joint **70** or **110** to form an upper frame portion. In the illustrated embodiment, center members **44** form an angle of approximately 140 degrees. The resulting A-frame type structure provides stability to the upper frame portion and to the frame **22** in general. It should be appreciated that the illustrated angle is exemplary only and should not be considered limiting. In this regard, center members **44** can be configured to be aligned, i.e., to form an angle of up to approximately 180 degrees, when the frame is erected. Alternatively, the angle formed by center members **44** can be less than approximately 140 degrees, e.g., 90 degrees or less. Moreover, embodiments are possible in which variation exists among the angles formed by the upper frame portions of different frames **22** that form the frame support **40**. These and other embodiments in which the center members **44** form different angels are contemplated and should be considered within the scope of the present disclosure.

Still referring to FIG. **2**, the opposite end of each of the center members **44** is coupled to an end of a lateral member **42** via a lateral frame joint **150** or **170**. Each lateral member **42** extends to the ground in a downward and laterally outward direction from its respective lateral frame joint **150** or **170**. In the preferred embodiment, each lateral member **42** includes an optional collapsible foot **200** disposed on an end of opposite the connection to the lateral frame joint **150** or **170**. Collectively, the lateral members **42** cooperate to form a lower frame portion that supports the upper frame portion. It will be appreciated that the orientation of the lateral members **42** in the disclosed embodiment are exemplary only and that the angle of each lateral member **42** relative to its associated central members **42** can vary. In this regard, the lateral members **42** can be more vertical or less vertical when the frame **22** is erected. In other contemplated embodiments, the angles formed by associated central members **42** and lateral members **42** can differ for a particular frame support **40** or between different frame supports **40**.

A plurality of purlin assemblies **180** couple each frame support **40** to the adjacent frame support or frame supports. For the end frame supports **40**A and **40**F, i.e., the frame supports at the longitudinal ends of the frame **22**, each purlin assembly **180** extends longitudinally toward the adjacent frame support. For the interior frame supports **40**B-**40**E, i.e., the frame supports with an adjacent frame support on each side, a plurality of purlin assemblies **180** extend longitudinally in each direction to couple the frame support to both adjacent frame supports. When the frame **22** is erected, the

purlin assemblies **180** ensure proper spacing between the frame supports **40** and also provide longitudinal stability to the frame **22**.

As will be described in further detail, each end of a given purlin assembly **180** is coupled to its respective frame support **40** to allow the purlin assembly to rotate relative to the frame support about a longitudinal axis, and to pivot about an axis normal to the longitudinal axis. Although the illustrated embodiment is shown to have purlin assemblies **180** located at the center frame joint **70** and **110** and each of the lateral frame joints **150** and **170**, it will be appreciated that this embodiment is just one example, and that the number of purlin assemblies and the attachment position of each purlin assembly to the frame supports can vary.

Referring now to FIGS. **6-8**, one example of a center frame joint **70** formed in accordance with aspects of the present disclosure will now be described. As shown in FIG. **6**, the center frame joint **70** maintains the orientation of the center members **44** relative to each other when the frame **22** is erected. As will be explained in further detail below, to facilitate the collapse of the frame **22**, the center frame joint **70** provides for selective rotation of the center members **44** relative to each other until the center members are generally parallel to each other, as shown in phantom lines in FIG. **6**.

FIG. **7** shows a partially exploded isometric view of the center frame joint **70** shown in FIG. **6**. The center frame joint **70** comprises two outer joint plates **72** and one or more inner joint plates **74**. The outer and inner joint plates **72**, **74** have substantially identical outer perimeters, forming almost completed cylinders **76** and **78**, respectively, with rectangular-like legs **80** and **82**, respectively, extending at angles therefrom. In the illustrated embodiment, the rectangular-like legs are sized and configured to be received within a center portion of the center members **44**.

Each outer joint plate **72** includes a central bore **84** and two outer bores in the form of a purlin pin bore **86** and a lock pin bore **88** aligned on either side of the central bore **84**. The inner joint plate **74** includes: (1) a central bore **90** sized and configured for corresponding with the central bores **84** of the outer joint plates **72**; (2) an arcuate slot **92** having a diameter corresponding to the purlin pin bore **86** of the outer joint plate **72**; and (3) a lock pin bore **94** sized and configured to cooperate with the lock pin bores **88** of the outer joint plates **72**. As illustrated, the outer and inner joint plates **72** and **74** include a hole sized and configured to accept a rod **106**, which is inserted into the hole and welded at each end to secure the joint plates **72** and **74** to the center members **44**. Alternate embodiments are contemplated in which the outer and inner joint plates include a plurality of holes for accepting cooperating fasteners for securement to the center members **44**. The legs **80** and **82** may also be secured to respective center members via welding or the like.

To assemble the center frame joint **70**, one or more inner joint plates **74** are placed together and aligned. Next, an outer plate **72** is placed on each side of the inner joint plate(s) **74** so that the central bores **84** and **90** align, but with the legs **80** of the outer plates **72** extending in the direction opposite of the leg(s) **82** of the inner joint plate(s) **74**. The inner joint plates **74** are then rotatably connected to the outer joint plates **72** by a cylindrical guide pin **98**. The guide pin **98** is retained therein by snap rings **96** that engage circumferential grooves **100** formed in opposing ends of the guide pin **90**. The guide pin **98** is optionally formed with a plurality of grooves **100** thereon in order to accommodate joints having different thicknesses.

A purlin pin assembly **120** has a central portion with a diameter corresponding to that of purlin pin bore **86** of the outer joint plate **72**. The purlin pin assembly **120** extends through the purlin pin bores **86** of the outer joint plates **72** and the arcuate slot **92** of the inner joint plate **74**. The purlin pin assembly **120** is retained therein by snap rings **96** that engage circumferential grooves **124** formed in opposing ends of the purlin pin assembly **120**. FIG. **8** shows one embodiment of a purlin pin assembly **120** suitable for use with the center frame joint **70** of one of the end frame supports **40**A and **40**F. The purlin pin assembly **120** includes a cylindrical pin **122** with circumferential grooves **124** formed at opposing ends thereof. In the disclosed embodiment, the cylindrical pin **122** has an inner pair of grooves **124** and an outer pair of grooves **124** formed thereon. As with the guide pins **90**, the two sets of corresponding grooves **124** allow a single purlin pin assembly **120** to be utilized in joints having different widths. The cylindrical pin **122** preferably includes a flat portion formed along one side. When utilized with the center frame joint **70**, the flat portion engages a flat portion of the purlin pin bore **86** to prevent the purlin pin assembly **120** from rotating within the purlin pin bore.

A lug **126** extends along a longitudinal axis from one end of the pin **122**. The purlin pin assembly **120** further includes a purlin fitting **128** having a cylindrical body **130** with a clevis **132** extending longitudinally from one end. The clevis **132** is sized and configured to engage the lug **126** of the pin **122**. A center pin **134** extends transversely through the clevis **132** and the lug **126** to rotatably couple the cylindrical body **130** of the purlin fitting **128** to the pin **122**. It will be appreciated that the described embodiment is just one example and that other configurations to rotatably couple the purlin fitting **122** to the pin **122** are possible and that such configurations should be considered within the scope of the present disclosure.

Referring back to FIG. **7**, rotation of the center joint **70** is limited by the travel of the purlin pin assembly **120** within the arcuate slot **92**. That is, as the center joint **70** rotates about the axis of the guide pin **98**, the purlin pin assembly **120** moves through the slot **92** until the purlin pin assembly abuts an end of the slot. At this point, the engagement of the purlin pin assembly **120** with the end of the slot **92** prevents further rotation of the center joint **70** in that direction. Thus, the purlin pin assembly **120** limits the rotation of the center joint **70** between a first position, in which the frame **22** is in an erected position, and a second position, in which the frame **22** is in a collapsed position. When the frame **22** is in the first (erected) position, a lock pin **102** is inserted through the lock pin bores **88** and **94** of the outer and inner joint plates **72** and **74** to temporarily fix the position of the center joint **70** in the first position. To move the center joint **70** to the collapsed position, the lock pin **102** is removed, and the center joint is free to rotate to the second position.

Still referring to FIG. **7**, when the center joint **70** is assembled, the purlin fitting **128** of the purlin pin assembly **120** extends outwardly from one side of the joint. The purlin fitting **128** is sized and configured to be received by the cylindrical end of the purlin assembly **180**. With the purlin fitting **128** engaging the end of the purlin assembly **180**, a set pin **104** is inserted into an aperture cooperatively formed by throughbores **136** and **56** that extends laterally through the purlin fitting **128** and the end of the purlin assembly **180**, respectively, thereby pivotally coupling one end of the purlin assembly **180** to the center joint **70**. When coupled to the center joint **70** in this manner, the purlin assembly **180** is free to rotate relative to the center joint about the pivot pin **134** that connects the pin **122** portion of the purlin pin assembly **120** to the purlin fitting **128**. The illustrated center joint **70** is one representative embodiment in accordance with the present disclosure; however, other configurations are contemplated and should be considered within the scope of the present

disclosure. In this regard, the described guide pin **98** can be a rivet, bolt/nut, or other fastener that couples the inner and outer joint plates together and provides rotation of each about a center axis. For such configurations, the number and location of the purlin assemblies **180** can vary from the illustrated embodiment

Referring now to FIGS. **9** and **10**, a center joint **110** suitable for use with interior frame supports **40**B-**40**E will be described. Referring to FIG. **9**, the illustrated center joint **110** is similar to the center joint **70** shown in FIG. **7**, wherein like reference numbers indicate like components. Unlike the center joint **70** of FIG. **7**, the center joint **110** of FIG. **9** uses a purlin pin assembly **140** with a purlin fitting **128** at each end instead of purlin pin assembly **120**, which has a single purlin fitting **128**.

As best shown in FIG. **10**, the illustrated embodiment of the purlin pin assembly **140** includes a cylindrical pin **142** with circumferential grooves **124** formed at opposing ends thereof. Similar to the cylindrical pin of the previously described purlin pin assembly **120**, the present purlin pin assembly **140** has a flat surface that engages a flat surface in the purlin pin bores **86** of the outer joint plates **72** to prevent the purlin pin assembly **140** from rotating relative to the outer joint plates. A lug **126** extends along a longitudinal axis from each end of the pin **142**. The purlin pin assembly **140** further includes a pair of purlin fittings **128**. Each purlin fitting **128** has a cylindrical body **130** with a clevis **132** extending longitudinally from one end. The clevis **132** is sized and configured to engage one of the lugs **126** of the pin **142**. At each end of the pin **142**, a center pin **134** extends transversely through the lug **126** and the clevis **132** of one of the purlin fittings **128** to rotatably couple the cylindrical body **130** of each purlin fitting **128** to an end of the pin **142**. As with the previously described purlin pin assembly **120**, it will be appreciated that the described embodiment is exemplary and that other configurations to rotatably couple the purlin fitting **128** to the pin **142** are possible and that such configurations should be considered within the scope of the present embodiment.

Referring back to FIG. **9**, the center joint **110** is assembled using a guide pin **98** and a purlin pin assembly **140** in a manner similar to the previously described center joint **70** of FIG. **7**. When the center joint **110** is assembled, a purlin fitting **128** extends from each side of the center joint. Each purlin fitting **128** is sized and shaped to be received within one end of a purlin assembly **180** and to be secured thereto with a set pin **104**. Accordingly, the center joint **110** is capable of having a purlin assembly **180** rotatably coupled to each side of the joint.

FIGS. **11** and **12** show one example of a lateral frame joint **150** for use with the end frame supports **40**A and **40**F in accordance with the present disclosure. As previously described, the lateral frame joint **150** rotatably connects one end of a center member **44** to an end of a lateral member **42**. As shown in FIG. **11**, when the frame **22** is erected, the center member **44** and the lateral member **42** are fixedly positioned relative to each other such that the members form an angle of approximately 110 degrees. It should be appreciated that the illustrated angle is exemplary only and should not be considered limiting. In this regard, the angle formed by a given center member **44** and the corresponding lateral member **42** when the frame **22** is erected can vary to accommodate any suitable frame configuration. As will be explained in more detail later, in order to facilitate the collapse of the frame **22**, the lateral frame joint **150** provides for selective rotation of the lateral member **42** relative to the center member **44** until the lateral member and center member are generally parallel to each other, as shown in phantom lines in FIG. **11**.

Referring now to FIG. **12**, a representative embodiment of a lateral frame joint **150** will be described. The lateral frame joint **150** includes a pair of joint plates **152** disposed on opposing sides of the end of the end of the lateral member **42**. As illustrated, the joint plates **152** are fixedly coupled to the lateral member **42** using rods **108** welded in place, as previously described with respect to the center frame joint **70**; however, it will be appreciated that the joint plate can be secured to the lateral member by fasteners, welding, or any other suitable attachment method. When coupled together, the lateral member **42** and the joint plates **152** cooperate to form a clevis on the end of the lateral member. A joint pin bore **154** extends through each joint plate **152** and is positioned to be offset from the edge of the lateral member **42**. Each joint plate further includes lock pin bore **160** formed therein. When the joint plates **152** are coupled to the lateral member, the joint pin bore **154** and lock pin bore **160** of one joint plate align with the corresponding joint pin bore and lock pin bore, respectively, of the opposing plate. As illustrated, the joint plates **152** also include a hole **112** through which a guide wire can be attached to the joint **150** to stabilize the shelter **20**, as shown in FIG. **1**.

Still referring to FIG. **12**, the end of the center member **44** is formed as a lug **156** with a central bore **158** having a size that corresponds to the joint pin bores **154** of the joint plates **152**. As illustrated, the lug **156** is integrally formed with the center member **44**; however, the lug can be a separately formed component fixedly secured to the center member using fasteners, welding, or any other suitable attachment method. The center member **44** further includes a lock pin bore **162** that aligns with the lock pin bores of the joint plates **152** when the frame is in an erected position.

The lateral member **42** and the center member **44** are rotatably coupled together by the previously described purlin pin assembly **120** extending through the joint pin bores **154** of the joint plates **152** and the central bore **158** of the center member **44**. As previously described with respect to center joint **70**, the purlin pin assembly **120** is retained within the joint by snap rings **96** that are disposed on opposing sides of the joint plates **152** and engage the grooves **124** of the purlin pin assembly **120**. Similar to the previously described purlin pin bore **86** of the center joint **110**, the joint pin bores **154** of the lateral frame joint **150** have a flat portion that engages a flat portion of the purlin pin assembly **120** to prevent the purlin pin assembly from rotating in the hole.

When the lateral frame joint **150** is assembled, a purlin fitting **128** extends from one side of the joint to allow a purlin assembly **180** to be pivotally coupled thereto, as previously described with respect to center joint **70** (see FIG. **7**). The lateral frame joint **150** is selectively lockable in the erected (open) position by inserting a lock pin **102** though the aligned lock pin bores **160** and **162**.

Referring now to FIG. **13**, an exemplary embodiment of a lateral frame joint **170** suitable for use with interior frame supports **40**B-**40**E, will be described. The lateral frame joint **170** is similar to the lateral frame joint **150** of FIGS. **11** and **12**, wherein like reference numbers indicate like components. Unlike the previously described lateral frame joint **150**, the lateral frame joint **170** of FIG. **13** uses purlin pin assembly **140**, which allows a purlin assembly **180** to be pivotally coupled to each side of the joint, as previously described with respect to center frame joint **110** (see FIG. **9**).

It will be appreciated that the illustrated lateral frame joints are exemplary only and other configurations are contemplated. For example, in one alternate embodiment, the joint plates are couple to the center member, and the lug is formed on the lateral member. In another example, a clevis that

engages the lug is integrally formed with either the lateral member or the center member. These and other variations will be apparent to those of ordinary skill in the art and should be considered within the scope of the present disclosure.

The purlin assemblies **180** extend longitudinally between adjacent frame supports to maintain spacing between the frame supports and to provide stability to the frame **22** when the frame is erected. Each purlin assembly **180** is pivotally coupled at each end to a frame support. In order to allow for the frame **22** to be collapsed without having to remove the purlin assemblies **180**, each purlin assembly is selectively foldable about a purlin mid joint **184**.

Referring to FIGS. **14** and **15**, one example of a purlin assembly **180** in accordance with the present disclosure will be described. Each purlin assembly includes a pair of elongate members **182**. The elongate members **182** are preferable formed from lightweight hollow tubing, such as round aluminum tubing, but it will be appreciated that the material and cross-sectional properties of the members can vary within the scope of the present disclosure.

The elongate members **182** are rotatably coupled about double-hinged purlin mid joint **184**. The purlin mid joint **184** includes center fitting **188** with a pair of lugs **190** extending in opposite directions. Rotatably attached to each lug **189** about a center pin **134** is a previously described, clevis-shaped purlin fitting **128**. Each purlin fitting **128** is in turn received within the end of one of the elongate members **182** and secured therein with a set pin **104**. The disclosed purlin mid joint **184** is just an example, and it is contemplated that various alternate double-hinge configurations can be utilized. Such configurations should be considered within the scope of the present disclosure.

A sleeve **186** is slidably associated with the elongate members **182**. When the members are positioned to be approximately coaxial, the sleeve **186** is selectively positionable over the purlin mid joint **184**. When so positioned, the sleeve **186** limits rotation of each elongate member **182** relative to the center fitting **188**, thereby securing the purlin assembly **180** in an extended position (see FIG. **14**). When the sleeve **186** is moved so that it does not cover the purlin mid joint **184**, the elongate members **182** are rotatable relative to the center fitting **188** so that the elongate members can be positioned to be generally parallel to each other in a "folded" position (see FIG. **15**). Thus, each purlin assembly **180** is selectively positionable between a locked, extended position and a folded position.

Referring now to FIGS. **16**A and **16**B, a rotatable base **200** is preferable coupled to the lower end of each lateral member **42** to help stabilize the shelter **20**. The rotatable base **200** includes a plate **202** with a pair of lugs **204** extending in a perpendicular direction from opposing sides of the plate **202**. The base **200** is rotatably coupled to the lower end of the lateral member **42** about a bolt, pin, or other suitable element that extends through holes formed in both plates **202** and the lateral member **42**.

When the shelter **20** is erected, the base **200** extends laterally from the lateral member **42** and provides a larger "footprint" to support the shelter (FIG. **16**A). The base **200** is selectively secured in the open position by a removable lock pin **102** that extends through a hole **206** formed in the lateral member **42** and at least one of the lugs **204**.

When the shelter **20** is collapsed the lock pin **102** at each base **200** is removed, and the base **200** is rotated into the position shown in FIG. **16**B. The lock pin **102** is then inserted back into the hole in the lateral member **42** for storage.

It will be readily apparent to one of ordinary skill in the art that various alternate embodiments of the exemplary disclosed shelter are possible without departing from the spirit and scope of the present disclosure. For example, the number, spacing, and erected form of the frame elements can vary to provide shelters of different sizes and shapes. Moreover, it is contemplated that two or more shelters can be connected end to end, by lateral passageways, or a combination thereof. In this manner, shelters of varying sizes with distinct, separate areas can be configured using a multitude of smaller, standard shelters. These and other variations of the disclosed embodiments are contemplated and should be considered within the scope of the disclosed subject matter.

Referring back to FIGS. **1-5**, one exemplary embodiment of a method for collapsing a portable shelter and, more specifically, a shelter frame, will be described. Starting with the erected shelter **20** of FIG. **1**, the tent-like structure **24** and associated guide wires, stakes, etc. are removed from the frame, shown in FIG. **2**. Next, the lock pins **102** are disengaged from the lateral frame joints **150** and **170**, and each lateral member **42** is rotated about the its respective joint until it is generally parallel with the corresponding center member **42**, as shown in FIG. **3**. Next, the purlin assemblies **180** are unlocked by sliding the sleeves **186** away from the purlin mid-joints. The frame supports **40**A-**40**F are moved together, as shown in FIG. **4**, with the purlin assemblies **180** folding inward between the frame supports. Finally, the lock pins **102** are disengaged from the center joints **70** and **110**, and the center members **44** are rotated relative to each other until they are generally parallel, as shown in FIG. **5**. The collapsed frame is optionally secured with straps, placed in a container, or otherwise secured in the collapsed state and is ready for transport. To erect portable shelter, these steps are simply reversed to proceed from the configuration shown in FIG. **5** to the configuration shown in FIG. **1**. It will be appreciated that the order of the steps of the described methods are exemplary only and should not be considered limiting. In this regard, the order of the steps may vary within the scope of the present disclosure.

The disclosed example of a collapsible shelter is advantageous over known shelters in that it allows for quick set up and disassembly by a minimum number of people. The lightweight construction combined with joints that keep the frame components connected, even when the shelter is disassembled, makes set up and disassembly more manageable so as to require fewer people. In this regard, the disclosed shelter can be easily set up by two or three people or, if necessary, by a single person. Further, the inclusion of lock pins and sleeves to selectively fix the various frame joints in their erected positions eliminates the need for tool and also makes assembly of the frame easier, as these locking devices inherently position the various frame elements when utilized. Moreover, the disclosed frame joints have a limited range of rotation, with the limits of rotation being the erected and collapsed joint positions. These and other disclosed features of the illustrated collapsible shelter combine to provide a shelter that is quickly and easily erected by a minimum number of people.

One or more embodiments described herein may be employed with a solar fly, one example of which is sold under the trademark THERMACAM. As best shown in FIG. **17**, one embodiment of a solar fly, generally designated **220**, includes a durable and flexible outer cover **252**. The outer cover **252** is of sufficient length to completely extend longitudinally over the shelter **20**, as best shown in FIG. **16**. Also, the outer cover **252** is of sufficient width to extend transversely over the majority of the shelter **20**. In one embodiment, the longitudinal edges of the outer cover **252** are positioned approximately 12-60 inches above ground or other supporting surface. On

the outer side of the solar fly **220**, a plurality of guy lines **260** may be employed in order to secure the solar fly **220** over the shelter **20**. The outer side of the solar fly **220** may also be contoured to so as not to hinder use of any doors that are optionally positioned on the side of the shelter.

The outer cover **252** in one embodiment is made of one or more layers of solid and/or low or non-gas permeable material such as a polyester reinforced vinyl fabric, military grade canvas fabrics, nylon fabrics, fabrics sold under the trademark CORDURA, military spec. 44103D fabrics, etc. The outer cover **252** includes one or more semi-permeable areas positioned in various locations of the outer cover **52**. In that regard, the outer cover **52** in several embodiments includes one or more longitudinally extending areas **290**A of mesh, such as vinyl mesh fabric, vinyl coated mesh, nylon mesh, military grade mesh fabric, wire mesh, etc., positioned at or near the crest or apex **292** of the roof **94** of the shade shelter **20**. The interstices of the longitudinally extending areas **290**A of mesh are sized and configured so as to permit air flow through the outer cover **252**, and in some embodiments, the interstices may be of a diamond configuration, hexagonal configuration, rectangular configuration, etc., just to name a few. In use, the areas **290**A may act like a vent to allow hot, rising air to escape through the solar fly **220** from the space formed between the outer cover **252** and the tent-like structure **24**, which may in turn, pull cooler air from the bottom of the longitudinal sides and ends of the solar fly, thereby creating convectional air flow sometimes referred to as a chimney effect.

In other embodiments, the outer cover **252** may also include one or more longitudinally extending areas **290**B of mesh, such as vinyl mesh fabric, vinyl coated mesh, nylon mesh, military grade mesh fabric, wire mesh, etc., positioned on the sides of the outer cover **52** at approximately the height of any windows of the associated shelter **20**. In some embodiments, the interstices of the longitudinally extending areas **290**B of mesh are sized and configured so as to provide visibility to the occupants of the shelter **24** so that the occupants may see through the windows and out through the outer cover **52**. Additionally or alternatively, the interstices of the longitudinally extending areas **290**B of mesh are sized and configured so as to permit air flow through the outer cover **252**. In some embodiments, the interstices may be of a diamond configuration, hexagonal configuration, rectangular configuration, etc., just to name a few.

In several embodiments, the semi-permeable areas, including areas **290**A, **290**B, provide between approximately 55-90% solar protection from the sun's rays. In one embodiment, the areas **290**A, **290**B provide approximately 85% solar protection from the sun's rays. In these or other embodiments, an optional blackout layer may be attached along the interior surface of the outer cover **252** other than in the semi-permeable areas, which solely, or in combination with the outer cover **252**, aid in the prevention of light emission through solar fly **220**. In one embodiment, the blackout layer is chosen so that the outer cover **252** provides greater than 80% and up to 100% solar protection from the sun's rays. One or more materials that can be employed in the blackout layer include but are not limited to carbon, carbon blends, etc. The outer cover **252** may have a camouflaged exterior color that matches the environment, if desired.

In a first embodiment, the over cover **252** of the solar fly **220** contacts and is supported by the frame supports **40**A-**40**E. In some embodiments, the solar fly can be spaced from the frame supports by spacers (not shown). Examples of spacers that may be practiced with embodiments of the present disclosure are set forth in detail in Provisional Application No. 61/653,948, filed May 31, 2012, the disclosure of which is hereby incorporated by reference in its entirety.

FIGS. **18**-**25** relate to aspects of another example of a collapsible frame **320** and associated elements and sub-elements, in accordance with aspects of the present disclosure. In some embodiments, the collapsible frame **320** is suitable to support a durable, flexible, outer cover (not shown) in order to form a temporary shelter. In these embodiments, the collapsible frame **320** is of the internal frame type. In other embodiments, the collapsible frame **320** is suitable to support a durable, flexible, tent-like structure suspended therefrom. In these embodiments, the collapsible frame is of the external frame type.

In the embodiment shown in FIG. **18**, the collapsible frame **320** is lightweight and easy-to-assemble. FIG. **18** shows an end view of the frame **320**; viewed in plan correspondingly to FIGS. **1** and **2**, a plurality of arched frame supports **340** (one of which is shown in collapsed form in FIG. **19**) would be visible, connected in a corresponding manner and in other ways (one of which is described below) which would be apparent to ordinarily skilled artisans. In FIG. **18**, the collapsible frame **320** is formed by a plurality of lightweight arched frame supports **340** (one of which is shown in collapsed form in FIG. **19**, as noted) spaced apart in a transversely disposed manner and interconnected by horizontally aligned purlins. Each arched frame support **340** comprises a plurality (shown as five) arch segments **340**A-**340**E connected end-to-end via joints **348**A, **348**B to form an integral member. In the embodiment shown, arch segments **340**D and **340**E are connected respectively to first ends of arch segments **340**B and **340**C via joints **348**A, while the opposite ends of arch segments **340**B and **340**C are connected respectively to opposite sides of the arch segment **340**A via joints **348**B.

FIG. **20** shows an exploded view of one example of the joint **348**A formed in accordance with aspects of the present disclosure. The joint **348**A comprises two outer joint plates **360**A and one or more inner joint plates **362**A. The outer and inner joint plates **360**A, **362**A have a substantially identical outer perimeter, forming an almost completed cylinder with a rectangular-like legs **368**A, **369**A extending respectively therefrom (See FIGS. **18** and **19**, in which these elements are unnumbered but nevertheless are readily visible). The outer joint plates **360**A each include a central bore **370**A and two outer bores in the form of a guide pin bore **372**A and a lock pin bore **374**A aligned on either side of the central bore **370**A. The inner joint plate **362**A includes: 1) a central bore **380**A sized and configured for corresponding with the central bore **370**A of the outer joint plates **360**A; two outer bores **382**A and **384**A sized and configured to cooperate with the lock pin bores **374**A of the outer joint plates **360**A in the erected position of FIG. **18** and the collapsed position of FIGS. **19**; and 3) an arcuate slot **386**A having a diameter corresponding to the guide pin bores **372**A of the outer joint plates **360**A. The outer and inner joint plates **360**A, **362**A may also include a plurality of holes **388**A for accepting cooperating fasteners for securement to the arch segments **340**A-**340**E.

To assemble the joint **348**A, an outer plate **360**A is placed on both sides of the inner joint plate **362**A so that the central bores **370**A, **380**A, are aligned, but with the legs **368**A of the outer plates **360**A extending in the direction opposite of the leg **369**A of the inner joint plate **362**A. The inner joint plate **362**A is then pivotably connected to the outer joint plates **360**A by pivot pin **390**A. Pivot pin **390**A can be a rivet, bolt/nut, or other fastener that couples the inner and outer joint plates together and provides rotation of each about a center axis. In some embodiments, the pivot pin **390**A may be configured similarly to guide pin **98** (FIG. **7**). In that regard,

the pivot pin **390**A can be retained within joint **348**A by snap rings **398**A that engage circumferential grooves **400**A formed in opposing ends of the guide pin **390**A. The guide pin **390**A is optionally formed with a plurality of such grooves **400**A thereon in order to accommodate joints having different thicknesses.

A guide pin **392**A (See also FIG. **24**) is then inserted into the cooperating aperture formed by the guide pin bore **372**A and guide slot **386**A. The guide pin **392**A in some embodiments may be configured similarly to cylindrical pin **122** (FIG. **7**). Once inserted, the guide pin **392**A can be retained by therein by snap rings **402**A that engage circumferential grooves **404**A formed in opposing ends of the guide pin **392**A. Once the joint **348**A is assembled, the inner joint plate **362**A is allowed to pivot with respect to the outer joint plates **360**A about the center axis formed by pivot pin **390**A from an erected position, such as that shown in FIG. **18**, to a collapsed position, such as that shown in FIG. **19**. Once in the extended or erected position shown in FIG. **18**, a lock pin **394**A, bolt and nut, etc., may be suitably coupled in aligned bores **374**A, **384**A so as to inhibit or lock movement of the inner joint plate **362**A with respect to the outer joint plates **360**A. In some embodiments, the bores **372**A have a flat portion similar to what is shown in FIGS. **7-10** with respect to purlin pin bore **86** and purlin pin assembly **120**. This type of configuration also may be described as a keyed configuration. Bores **372**A then cooperate with a correspondingly shaped guide pin **392**A so that the guide pin is prevented from rotating, similarly to the arrangement and relationship in FIGS. **7-10**.

The joint **348**A shown in FIG. **20** is suitable for the end frame supports **340** of the collapsible frame **320**. For the joints of the frame supports **340** positioned in-between the end frame supports, the joint **348**A' shown in FIG. **21** can be used. The joint **348**A' is substantially identical in construction and operation to the joint **348**A of FIG. **20** except for the differences that will now be described in detail. As shown in FIGS. **21** and **25**, a guide pin **392**A' with opposing lugs **126**A' is employed instead of the single lugged guide pin **392**A of FIG. **20**. In that regard, the opposing lugs **126**A' can be employed for coupling to purlins on both sides of the frame support **340**.

FIG. **22** shows an exploded view of an example of the joint **348**B formed in accordance with aspects of the present disclosure. The joint **348**B is substantially identical in construction and operation as the joint **348**A of FIG. **20** except for the differences that will now be described in detail. As shown in FIG. **22**, the length of the elongate arcuate slot **386**B is less than the arcuate slot **386**A. As a result, once assembled, the inner joint plate **362**B is allowed to pivot with respect to the outer joint plates **360**B about the center axis formed by pivot pin **390**B from an erected position, such as that shown in FIG. **18**, to a collapsed position shown in FIG. **19**. Due to the configuration of arcuate slot **386**B and the configuration and arrangement of the joint **348**B, the lock pin bore **374**B and outer bores **382**B, **384**B are located at different positions about the central bores **370**B, **380**B.

The joint **348**B shown in FIG. **22** is suitable for the end frame supports **340** of the collapsible frame **320**. For joints of frame supports **340** positioned in-between the end frame members, the joint **348**B' shown in FIG. **23** can be used. The joint **348**B' is substantially identical in construction and operation as the joint **348**B of FIG. **22** except for the differences that will now be described in detail. As shown in FIGS. **23** and **25**, a guide pin **392**B' with opposing lugs **126**B' is employed instead of the single lugged guide pin **392**B of FIG. **22**. In that regard, the opposing lugs **126**B' can be employed for coupling to purlins on both sides of the frame support **340**.

The principles, representative embodiments, and modes of operation of the present disclosure have been described in the foregoing description. However, aspects of the present disclosure which are intended to be protected are not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. It will be appreciated that variations and changes may be made by others, and equivalents employed, without departing from the spirit of the present disclosure. Accordingly, it is expressly intended that all such variations, changes, and equivalents fall within the spirit and scope of the claimed subject matter.

What is claimed is:

1. A frame support for a portable shelter frame, the frame support being selectively articulable between an erected state and a collapsed state, the frame support comprising:

a central frame member;

a pair of upper arcuate frame members;

a pair of first joints each coupled to one end of the central frame member, and respectively to one end of each of the pair of upper arcuate frame members, so that the upper arcuate frame members are rotatably coupled to the central frame member, and so that each pair of upper arcuate frame members is selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state;

a pair of lower arcuate frame members; and

a pair of second joints each coupled respectively to the other ends of the pair of upper arcuate frame members, and to one end of each of the pair of lower arcuate frame members, so that respective ones of upper and lower arcuate frame members are rotatably coupled to each other, and so that each pair of lower arcuate frame members is selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state,

wherein the second joints each include a guide pin and an arcuate slot, wherein the guide pin travels within the arcuate slot as the lower arcuate frame member moves between the first, fixed position and the second, fixed position.

2. The frame support of claim **1**, wherein the first joints and the second joints each comprise a pivot pin assembly defining an axis of rotation of the respective joints.

3. A frame assembly comprising at least first and second frame supports according to claim **1**,

the frame assembly further comprising a plurality of purlin assemblies interconnecting the first and second frame supports,

each purlin assembly including first and second purlin members rotatably coupled about a purlin mid-joint, and each purlin assembly being selectively lockable in an extended position when the frame is in the erected state, the purlin members being rotatable to a folded position when the frame is in the collapsed state,

the purlin assemblies being pivotally coupled to the first frame support and the second frame support at their respective first and second joints.

4. The frame assembly of claim **3**, wherein each purlin assembly further comprises a sleeve slidably associated with the first purlin member, the sleeve being selectively positionable to lockingly engage the purlin assembly mid-joint.

5. The frame assembly of claim **3**, wherein the first purlin member is rotatable about the axis of rotation of the first respective joint.

6. The frame assembly of claim 5, wherein the first purlin member is rotatable about a second axis of rotation normal to the axis of rotation of the first respective joint.

7. The frame assembly of claim 6, wherein the second purlin member is rotatable about the axis of rotation of the second respective joint.

8. The frame assembly of claim 6, wherein the first purlin member is rotatable about a second axis of rotation normal to the axis of rotation of the first respective joint, and wherein the second purlin member is rotatable about a third axis of rotation normal to the axis of rotation of the second respective joint.

9. The frame assembly of claim 3, wherein the first joints each include a guide pin and an arcuate slot, wherein the guide pin travels within the arcuate slot as the upper arcuate frame member moves between the first, fixed position and the second, fixed position, and wherein each guide pin has a lug at one end thereof for coupling to one of the purlin assemblies.

10. A frame assembly comprising at least first, second, and third frame supports according to claim 1, the first and second frame supports being positioned at opposite ends of the frame assembly, and the third frame support being positioned between the first and second frame supports,

the frame assembly further comprising a plurality of purlin assemblies interconnecting the first, second, and third frame supports,

each purlin assembly including first and second purlin members rotatably coupled about a purlin mid-joint, and each purlin assembly being selectively lockable in an extended position when the frame is in the erected state, the purlin members being rotatable to a folded position when the frame is in the collapsed state,

some of the purlin assemblies being pivotally coupled to the first frame support and third frame support at their respective first and second joints, and the other purlin assemblies being pivotally coupled to the second frame support and the third frame support at their respective first and second joints.

11. The frame assembly of claim 10, wherein each of the first joints for the first and second frame supports includes a guide pin and an arcuate slot, wherein the guide pin travels within the arcuate slot as the upper arcuate frame member moves between the first, fixed position and the second, fixed position, and wherein each guide pin has a lug at one end thereof for coupling to one of the purlin assemblies.

12. The frame assembly of claim 10, wherein each of the first joints for the third frame support includes a guide pin and an arcuate slot, wherein the guide pin travels within the arcuate slot as the upper arcuate frame member moves between the first, fixed position and the second, fixed position, and wherein each guide pin has a lug at opposite ends thereof for coupling to two of the purlin assemblies.

13. The frame assembly of claim 10, further comprising two or more additional frame supports according to claim 1, the additional two or more frame supports also being disposed between the first and second frame supports,

the frame assembly further comprising additional purlin assemblies according to claim 10, the additional purlin assemblies interconnecting the two or more additional frame supports to the first, second, and/or third frame supports at their respective first and second joints.

14. A frame support for a portable shelter frame, the frame support being selectively articulable between an erected state and a collapsed state, the frame support comprising:

a central frame member;

a pair of upper arcuate frame members;

a pair of first joints each coupled to one end of the central frame member, and respectively to one end of each of the pair of upper arcuate frame members, so that the upper arcuate frame members are rotatably coupled to the central frame member, and so that each pair of upper arcuate frame members is selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state;

a pair of lower arcuate frame members; and

a pair of second joints each coupled respectively to the other ends of the pair of upper arcuate frame members, and to one end of each of the pair of lower arcuate frame members, so that respective ones of upper and lower arcuate frame members are rotatably coupled to each other, and so that each pair of lower arcuate frame members is selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state,

wherein the first joints each include a guide pin and an arcuate slot, wherein the guide pin travels within the arcuate slot as the upper arcuate frame member moves between the first, fixed position and the second, fixed position.

15. The frame support of claim 14, the first joints comprise outer and inner guide plates, each of the outer and inner guide plates having a guide pin bore with a cross section having an arcuate portion and a flat portion, and wherein the guide pin has a cross section corresponding to that of the guide pin bore, so that the guide pin is prevented from rotating in the guide pin bore as the guide pin travels within the arcuate slot.

16. A frame support for a portable shelter frame, the frame support being selectively articulable between an erected state and a collapsed state, the frame support comprising:

a central frame member;

a pair of upper arcuate frame members;

a pair of first joints each coupled to one end of the central frame member, and respectively to one end of each of the pair of upper arcuate frame members, so that the upper arcuate frame members are rotatably coupled to the central frame member, and so that each pair of upper arcuate frame members is selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state;

a pair of lower arcuate frame members; and

a pair of second joints each coupled respectively to the other ends of the pair of upper arcuate frame members, and to one end of each of the pair of lower arcuate frame members, so that respective ones of upper and lower arcuate frame members are rotatably coupled to each other, and so that each pair of lower arcuate frame members is selectively moveable between a first, fixed position when the frame support is in the erected state and a second, fixed position when the frame support is in the collapsed state,

wherein an arc length of an arcuate slot of the second joints is greater than an arc length of an arcuate slot of the first joints.

17. A joint for connecting two arcuate frame members, the joint comprising:

at least first and second plate members;

a pivot pin assembly defining an axis of rotation between the first and second plate members; and

a guide pin associated with the first plate member and an arcuate slot disposed in the second plate member,

wherein the guide pin travels within the arcuate slot as one of the two arcuate frame members moves between a first, fixed position and a second, fixed position,

wherein the at least first and second plate members include a guide pin bore with a cross section having an arcuate portion and a flat portion, and wherein the guide pin has a cross section corresponding to that of the guide pin bore, so that the guide pin is prevented from rotating in the guide pin bore as the guide pin travels within the arcuate slot.

18. The joint of claim **17**, wherein each guide pin has a lug at one end thereof for coupling to a purlin assembly.

19. The joint of claim **17**, wherein each guide pin has a lug at opposite ends thereof for coupling to respective purlin assemblies.

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